

**ACOUSTIC AND PERCEPTUAL PHONETICS**

**Instructor:** Rochelle Newman, Room 0141BB Lefrak, (301) 405-4226

**Office hours:** Tuesday, 3:30-4:30, Thursday 2-3, and by appointment

**e-mail:** rnewman@hesp.umd.edu

**Class Time:** Tuesdays, 1 to 3:30 PM

**Place:** HESP Conference room

This course is aimed at a study of the physical patterns (acoustic) of speech sounds and the importance of these acoustic patterns to speech recognition (perception). The course will focus on segmental phonemes (vowels and consonants) and on suprasegmental characteristics such as stress and intonation. Although much of the course will focus on speech produced by English-speaking adults, you will also learn how these speech sounds change in a variety of disorders. By the end of this course, you should be able to demonstrate knowledge of the nature of speech (both acoustic and articulatory) and how it is perceived.

The first half of the course will focus on acoustic phonetics -- In this portion of the course, you will learn the different types of speech analysis techniques, and how to use these to study the acoustic patterns of speech sounds. During the last part of the course, we will turn to perceptual phonetics, and you will learn how these different aspects of the speech signal relate to listener perception. You will also learn about the use of synthetic speech.

As part of this course, you will do a number of laboratory exercises. These will use a variety of different analysis programs, all available as freeware downloads. Thus, as part of the course, you will receive hands-on training in doing acoustic analyses of the speech signal.

Lecture presentations are in power point, and copies of the slides can be downloaded from the following web site

[http://www.bsos.umd.edu/hesp/newman/Newman\\_classes/Newman604/604.html](http://www.bsos.umd.edu/hesp/newman/Newman_classes/Newman604/604.html)

**Text:** Pickett, J.M. (1999). *The Acoustics of Speech Communication: Fundamentals, speech perception theory, and technology*. Boston, Allyn and Bacon.

*This text is recommended, but is not required.*

**Articles:** All articles for the class are available in the course ELMS/BLACKBOARD website

**Learning outcomes:**

After completing this course, a student will be able to:

- Compare & contrast different types of speech analysis techniques and the limitations of each
- Summarize the acoustic, articulatory, and phonetic patterns for the sounds of English, and recognize the spectrographic patterns for these sounds

- Integrate knowledge of acoustic & articulatory phonetics with what is known about a variety of clinical populations, and thus make predictions as to the sources of difficulties experienced in those populations
- Be able to use different computer programs to analyze acoustic properties of speech.
- Explain current issues in the field of speech perception

## **GRADES**

Your final grade is based on the following:

**1. Laboratory work** [42%] and class participation [5%].

Your overall involvement with the laboratory exercises and your class participation will be evaluated. There are a total of 28 laboratory exercises over the course of the semester; each is worth 1.5 percentage points total, for 42% of your final grade.

**2. Take-home assignment** [5%].

You will be given a sound spectrogram of a short utterance of connected speech and will be asked to: (1) segment the vowels and consonants, (2) then for each segment, to identify the class of speech sound it is (vowel, diphthong, glide, liquid, stop, nasal, fricative, or affricate), and possibly the gender and age range of the speaker. You will also be asked to give your best guess as to exact identity of each segment. The assignment will have complete instructions.

**3. Six thought papers:** 1-page each. [18%]

These can be on any of the days on which there are article readings; there are 9 such days. You may choose which days to turn ones in, so if you have nothing to say about the readings one day you may choose that day as one of the “free” days. I do not want a summary of the articles you read. Rather, I want any thoughts or questions that you came up with while doing the reading. These will be graded on a check, check-plus, check-minus basis.

**4. Two Exams** (one midterm, one final) [15% each, or 30% total].

## **Policies**

*Accommodations for students with disabilities or special needs:* If you have special needs with regards to this class, please contact me as soon as possible so that appropriate accommodations can be arranged.

*Academic Honesty:* All students are expected to adhere to campus policy on academic integrity. Cheating on academic work will not be tolerated in any form, and will be subject to strong penalties in this class and the university system. If you cheat on a paper or assignment, you risk failing the class, as well as suspension or expulsion from the University as a whole.

Academic dishonesty includes, but is not limited to, misrepresenting someone else’s work as your own, falsifying any information in a citation or academic exercise, using unauthorized materials in any academic exercise, or helping (or attempting to help) another to commit an act

of academic dishonesty. You are expected to work together on your in-class lab assignments, but not on your take-home assignment or on any exams. If you miss a day of lab, you are expected to then make up that lab assignment on your own time. Getting the answers from a classmate who attended lab that day is NOT acceptable.

***Late assignments:*** I expect your assignments to be turned in by the beginning of class on the due date. If an absence can be anticipated in advance, you must turn in assignments PRIOR to the scheduled date. In the case of a documented emergency preventing you from turning in an assignment on time, you MUST notify me BEFORE the assignment would normally be due. (Thus, if an emergency prevents you from attending class, you must inform me of this prior to classtime). I will accept assignments that are late for other (non-emergency) reasons, but your grade will be reduced by one grade for each day your assignment is late.

## CLASS SCHEDULE

**September 1**            ORIENTATION, INTRODUCTION, AND SOME BASIC REVIEW  
Review of basic concepts in phonetics (phonemes, vowels, consonants, place of articulation, manner of production, speech sound sources), and begin reviewing basic concepts in acoustics.

**September 8**            COMPLEX SOUNDS, DIGITAL SIGNAL PROCESSING  
We will go over the basics of acoustics, and some types of signal processing  
*Recommended:*        *Chapter 1. Language, Phonetics, and Speech Production.*  
                                 *Chapter 2. Sounds, Resonance, and Spectrum Analysis.*

**September 15**            **DR. NEWMAN AWAY; NO CLASS**

**September 22:**        TUBE THEORY, SOURCE FILTER THEORY  
Discussion of source-filter theory and vowel formants. Modification of glottal sound source by the shape of the oral cavity. Demonstration with Electrolarynx.

**Assignments due:**    **Lab exercise 1 - Digital Signal Processing**  
                                 **Lab exercise 2 – Measuring pitch**

*Recommended reading:*    *Chapter 3. Vowel shaping and vowel formants.*  
   *Chapter 4, Glottal sound source and the spectra of vowels.*

**Sept. 29**                SPECTROGRAMS, OTHER VOWELS  
Beginning of spectrogram reading. Understanding of different vowels.

**Assignments due:**    **Lab exercise 3 - Change the gender**  
                                 **Lab exercise 4 – Tube Model**  
                                 **Lab exercise 5 – ESystem Vowels**  
                                 **Lab exercise 6 – Graphing your vowel space**

*Note: The last assignment may make more sense after today's lecture; but I wanted to space out the assignments some.*

**ARTICLE:** Jenkins, J. J. (1987). A selective history of issues in vowel perception. *Journal of Memory & Language*, 26(5), 542-549.  
*(although quite dated, this is a nice review of the early history of research on vowels)*

**October 6** FINISH VOWELS; DISCUSS LAB EXERCISES;  
CONSONANTS: MANNER OF ARTICULATION

Spectral and temporal characteristic of the different manners of consonant articulation.

**Assignments due:** Lab exercise 7 – Narrowband vs Wideband Spectrograms  
Lab exercise 8 – Vowels in isolation  
Lab exercise 9 – Front vowels in CVCs  
Lab exercise 10 – Back vowels in CVCs  
Lab exercise 11 – Diphthongs in CVs

*Recommended:* Chapter 6, Consonant features, glides and stops  
Chapter 7, Consonants: Nasal, stop, and fricative manners of articulation

**October 13: EXAM #1 (through vowels, only)**

**October 20: CLASS STARTS 1 hour late (2:00)**

REVIEW EXAM

CONSONANTS: MANNER OF ARTICULATION, VOICING & PLACE

SPECTROGRAM READING

Spectral and temporal characteristic of voicing and of place of articulation in consonants. A discussion of VOT, and the classic research on this topic.

**Receive take-home assignment**

**Assignments due:** Lab exercise 12 – Glides and Stops  
Lab exercise 13 – Liquids  
Lab exercise 14 – Telephones

**ARTICLE:** Lisker, L. & Abramson, A.S. (1964). A cross-language study of voicing in initial stops: Acoustical measurements. *Word*, 20(3), 384-422. READ PAGES 384-391, then compare values across languages; then read 398-407, and summary at end.

*(another dated article, but a classic on how languages differ....)*

*Recommended:* Chapter 8, Consonants: The voiced-unvoiced contrast  
Chapter 9, Acoustic effects related to place of articulation

**October 27** SPECTROGRAM READING  
DISORDERED PRODUCTION/PERCEPTION

**Assignments due:**                   **Lab exercise 15 – Oral Stops and Fricatives**  
   **Lab exercise 16 – Word-initial Voicing**  
   **Lab exercise 17 – Word-final voicing in Stops & Fricatives**

*In preparation for next week, read:*

**ARTICLE:** Miller, J. L. (1990). Speech perception. In D. N. Osherson & H. Lasnik (Eds.), *An invitation to cognitive science: Language*. Vol. 1. Cambridge: MIT Press. pgs. 69-93.

**November 3** SPEECH PERCEPTION – EARLY RESEARCH, & CATEGORICAL PERCEPTION

**Assignments due:**                   **Take-home assignment**  
   **Lab exercise 18 - Categorical Perception**

**ARTICLE:** Eimas, P. D. & Corbit, J. D. (1973). Selective adaptation of linguistic feature detectors. *Cognitive Psychology*, 4, 99-109.

**ARTICLE:** Kuhl, P. K. & Miller, J. D. (1975). Speech perception by the chinchilla: Voiced-voiceless distinction in alveolar plosive consonants. *Science*, 190 (4209), 69-72.

**ARTICLE:** Rosen, S. & Howell, P. (1987). Auditory, articulatory, and learning explanations of categorical perception in speech. In S. Harnad (Ed.), *Categorical perception: The groundwork of cognition*. Cambridge: Cambridge University Press. (p. 113-160; but only read pages 113-124.)

**November 10** LACK OF INVARIANCE/COARTICULATION (ARTICLES 1&2)  
MINIMAL CUES (ARTICLES 3&4)  
(start of slides on perceptual issues)

**Assignments due:**                   **Lab exercise 19 – Coarticulation**  
   **Lab exercise 20 – Sound of Silence**  
   **Lab exercise 21 – Cutting up a damp skunk**

**ARTICLE:** Strange, W. (1987). Information for vowels in formant transitions. *Journal of Memory & Language*, 26(5), 550-557.

**ARTICLE:** Kluender, K. R, Diehl, R. L., & Killeen, P. R. (1987). Japanese quail can learn phonetic categories. *Science*, 237, 1195-1197.

**ARTICLE:** Remez, R. E., Rubin, P. E., Pisoni, D. B., & Carrell T. D. (1981). Speech perception without traditional speech cues. *Science*, 212, 947-950.

**ARTICLE:** Shannon, R. V., Zeng, F.-G., Kamath, V., Wygonski, J., & Ekelid, M. (1995). Speech recognition with primarily temporal cues. *Science*, 270, 303-304.



