



# Electrophysiological Measurements

HESP 630  
Fall 2017

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Meeting Time: Mondays, 3:30 - 6:00 PM  
Meeting Location: Lefrak Hall, Room 0135  
Prerequisites: HESP 606 and 706

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## Learner Outcomes\*

This course covers the clinical use of electrophysiological methods for assessment, diagnosis, and management of individuals who may have peripheral or central hearing loss.

1. Describe principles of EEG recording
2. Administer and interpret electrophysiological measures (ABR, ECoG, ASSR) to
  - a. Estimate hearing thresholds in infants and other individuals who are difficult-to-test
  - b. Perform differential diagnosis
3. Describe applications of FFR, MLR, and LLR in assessment of auditory processing and brain injury
4. Describe applications of EEG measurements for evaluation of cochlear implant, hearing aid, and treatment outcomes
5. Critically evaluate new research that aims to improve diagnosis and management of auditory disorders

Each student's knowledge and skills in these areas will be determined by the following assessment procedures:

1. Written examinations (one midterm examination and one final examination)
2. Practical examination
3. Article review
4. On-line quizzes
5. Laboratory exercises

\*See p. 9 for the Audiology Knowledge and Skills addressed by specific learning outcomes

## Required Reading:

Katz et al. (2015). *Handbook of Clinical Audiology, Seventh Edition*. Philadelphia: Lippincott Williams & Wilkins

Selected articles

## Course Schedule

Module 1 – ABR Recording Principles and Neurophysiology	
August 28	Introduction; Overview of electrophysiological measurement; Patient preparation and recording tips; Neurophysiology
In-class activities	Lecture Demonstration of electrode application
Outside activities	Readings: 1. Katz, Text, Chapter 11 2. <a href="http://www.asha.org/policy/KS2003-00020/">http://www.asha.org/policy/KS2003-00020/</a> 3. AAA Audiology Protocol - Electrophysiologic (EP) Evaluation
September 11 Neurophysiology; Instrumentation; Acquisition; Recording	
In-class activities	Kahoot! Lab 1 Demo Lecture
Outside activities	Readings: 1. *Parthasarathy, T. K., Borgsmiller, P., & Cohan, B. (1998). Effects of repetition rate, phase, and frequency on the auditory brainstem response in neonates and adults. <i>J Am Acad Audiol</i> , 9(2), 134-140 Quiz 1 Lab 1 ABR Parameters
September 18 Principles of analysis and interpretation Electrocochleography	
In-class activities	Kahoot! Article review #1 Lab 2 demo Lecture
Outside activities	Readings: 1. Katz, Text, Chapter 12 2. *Stuermer, K. J., Beutner, D., Foerst, A., Hahn, M., Lang-Roth, R., & Walger, M. (2015). Electrocochleography in children with auditory synaptopathy/neuropathy: Diagnostic findings and characteristic parameters. <i>Int J Ped Otolaryngol</i> , 79(2), 139-145. 3. *Stuermer, K. J., Beutner, D., Streicher, B., Foerst, A., Felsch, M., Lang-Roth, R., et al. (2015). The correlation between ECoChG parameters and early auditory behavior after cochlear implantation in children. <i>Int J Audiol</i> , 55(7), 412-418. Quiz 2 Lab 2 Electrocochleography
Module 2 – ABR Clinical Applications	
September 25 Differential diagnosis	
In-class activities	Kahoot! Article review #2 Lab 3 demo Lecture
Outside activities	Readings: 1. Katz, Text, Chapter 13 2. *Kochanek, K. M., Sliwa, L., Golebiowski, M., Pilka, A., Skarzynski, H. (2015). Comparison of 3 ABR methods for diagnosis of retrocochlear hearing impairment. <i>Med Sci Monit</i> , 21, 3814-3824.

	<p>3. *Don, Manuel, Kwong, Betty, &amp; Tanaka, Chiemi. (2012). Interaural stacked auditory brainstem response measures for detecting small unilateral acoustic tumors. <i>Audiol Neurotol</i>, 17(1), 54-68.</p> <p>Quiz 3 Lab 3 Two-channel recording</p>
October 2	Hearing Threshold Estimation - Tone-burst ABR
In-class activities	Kahoot! Lab 4 demo Lecture
Outside activities	<p>Readings:</p> <ol style="list-style-type: none"> <li>1. Katz, Text, Chapter 14</li> <li>2. *Ferm, I., Lightfoot, G., &amp; Stevens, J. (2013). Comparison of ABR response amplitude, test time, and estimation of hearing threshold using frequency specific chirp and tone pip stimuli in newborns. <i>Int J Audiol</i> 52(6), 419-423.</li> <li>3. *Elsayed, A. M., Hunter, L. L., Keefe, D. H., Feeney, M. P., Brown, D. K., Meinzen-Derr, J. K., et al. (2015). Air and bone conduction click and tone-burst auditory brainstem thresholds using Kalman Adaptive Processing in nonsedated normal-hearing infants. <i>Ear Hear</i>, 36(4), 471-481.</li> </ol> <p>Quiz 4 Lab 4 Threshold ABR</p>
October 9	Pediatric clinical applications; ABR Wrap-up
In-class activities	Review for midterm Peak-picking practice Article review #3
October 16	Midterm
<b>Module 3 - Advanced EEG</b>	
October 23	Auditory Steady-State Response
In-class activities	Midterm review Lab 5 Demo Lecture
Outside activities	<p>Quiz 5 Lab 5 - ASSR</p> <p>Readings:</p> <ol style="list-style-type: none"> <li>1. Katz, Text, Chapter 15</li> <li>2. *Beck, R. M. d. O., Grasel, S. S., Ramos, H. F., Almeida, E. R. d., Tsuji, R. K., Bento, R. F., et al. (2015). Are auditory steady-state responses a good tool prior to pediatric cochlear implantation? <i>International Journal of Pediatric Otorhinolaryngology</i>, 79(8), 1257-1262.</li> <li>3. *Karawani, H., Attias, J., Shemesh, R., Nageris, B. (2015). Evaluation of noise-induced hearing loss by auditory steady-state and auditory brainstem-evoked responses. <i>Clin Otolaryngol</i>, 40, 672-681</li> </ol>
October 30	Intraoperative neurophysiological monitoring
In-class activities	Kahoot! Lecture Article Review #4
Outside activities	<p>Quiz 6</p> <p>Readings:</p> <ol style="list-style-type: none"> <li>1. Katz, Text, Chapter 16</li> <li>2. *Attias, J., Nageris, B., Ralph, J., Vajda, J., &amp; Rappaport, Z. H. (2008). Hearing preservation using combined monitoring of extra-tympanic</li> </ol>

	electrocochleography and auditory brainstem responses during acoustic neuroma surgery. <i>International Journal of Audiology</i> , 47(4), 178-184.
November 6	<b>Central auditory processing, Part I - cABR/FFR</b>
Outside activities	On-line lecture On-line demonstration of Lab 6 Readings: 1. *Rocha-Muniz, Caroline N, Befi-Lopes, Debora M, & Schochat, Eliane. (2012). Investigation of auditory processing disorder and language impairment using the speech-evoked auditory brainstem response. <i>Hear Res</i> , 294(1), 143-152. 2. Kraus, N., & Anderson, S. (2017). Auditory Processing Disorder: Biological basis and treatment efficacy. In R. R. Fay & A. N. Popper (Eds.), <i>Translational Research in Audiology and the Hearing Sciences: An Essential Guide for Scientists and Clinicians</i> (Vol. Springer Handbook of Auditory Research, pp. 299-318). New York: Springer. Quiz 7 Lab 6 - FFR
November 13	<b>Central auditory processing, Part II - Middle Latency Response</b>
In-class activities	Kahoot! Lecture Lab 7 demo Article Review #5
Outside activities	Lab 7 - MLR Readings: 1. Katz Handbook Chapter 17 2. *Weihing, J., Schochat, E., & Musiek, F. (2012). Ear and electrode effects reduce within-group variability in middle latency response amplitude measures. <i>Intl J Audiol</i> , 51(5), 405-412.
November 20	<b>Central auditory processing, Part III - Cortical Auditory-Evoked Potentials</b>
Outside activities	On-line lecture On-line demonstration of Lab 8 Quiz 8 Lab 8 - Cortical Readings: 1. Katz Handbook Chapter 18 2. *Almeqbel, A., & McMahon, C. (2015). Objective measurement of high-level auditory cortical function in children. <i>Int J Pediatr Otorhinolaryngol</i> , 79(7), 1055-1062. 3. *Anderson, S., Chandrasekaran, B., Yi, H.-G., & Kraus, N. (2010). Cortical-evoked potentials reflect speech-in-noise perception in children. <i>European Journal of Neuroscience</i> , 32(8), 1407-1413.
<b>Module 4 – Advanced EEG Applications</b>	
November 27	<b>Challenging populations: Management of CIs and hearing aids using evoked potentials</b>
In-class activities	Kahoot! Article review #4 Lecture
Outside activities	Quiz 7 Readings: 1. *Munro, Kevin J, Purdy, Suzanne C, Ahmed, Sadia, Begum, Rushanara, & Dillon, Harvey. (2011). Obligatory cortical auditory evoked potential waveform detection and differentiation using a commercially available clinical system: HEARLab™. <i>Ear Hear</i> , 32(6), 782-786.

	<ol style="list-style-type: none"> <li>2. *Cardon, G., &amp; Sharma, A. (2013). Central auditory maturation and behavioral outcome in children with auditory neuropathy spectrum disorder who use cochlear implants. <i>Intl J Audiol</i> (0), 1-10.</li> <li>3. *Easwar, V., Purcell, D. W., Aiken, S. J., Parsa, V., &amp; Scollie, S. D. (2015). Evaluation of speech-evoked envelope following responses as an objective aided outcome measure: Effect of stimulus level, bandwidth, and amplification in adults with hearing loss. <i>Ear Hear</i>, 36(6), 635-652.</li> </ol>
December 4	Objective assessment of treatment efficacy
In-class activities	Kahoot! Article review #6 Lecture
Outside activities	<b>Readings:</b> <ol style="list-style-type: none"> <li>1. Anderson, S., &amp; Jenkins, K. (2015). Electrophysiologic assessment of auditory training benefits in older adults. <i>Semin Hear</i>, 36(04), 250-262.</li> <li>2. *Anderson, S., White-Schwoch, T., Parbery-Clark, A., &amp; Kraus, N. (2013). Reversal of age-related neural timing delays with training. <i>Proc Natl Acad Sci - USA</i>, 110(11), 4357-4362.</li> <li>3. *Filippini, R., Befi-Lopes, D. M., &amp; Schochat, E. (2012). Efficacy of Auditory training using the auditory brainstem response to complex sounds: auditory processing disorder and specific language impairment. <i>Folia Phoniatrica et Logopaedica</i>, 64(5), 217-226.</li> </ol>
December 11	Discussion of case studies; Review for final
In-class activities	Review questions
Outside activities	Study for Final ☺
December 18	<b>Final</b>

<b>Learning Assessments</b>	<b>#</b>	<b>Points Each</b>	<b>Category Total</b>	<b>Category Weight</b>
Reading Quizzes	6	20	120	16%
Lecture/Reading Quizzes	2	40	80	11%
Article presentations	1	25	25	3%
Labs	8	25	200	27%
Midterm	1	150	150	20%
Final (150 written, 25 practical)	1	175	175	23%
<b>Total Points:</b>			<b>750</b>	

<b>Final Grade Cutoffs</b>					
+	98.00%	+	88.00%	+	78.00%
		+	68.00%		
A	94.00%	B	84.00%	C	74.00%
		D	64.00%	F	<60.0%
-	90.00%	-	80.00%	-	70.00%
		-	60.00%		

## Guidelines for Practical Lab Exercises & Reports

The lab exercises are designed to help you put into practice the concepts and procedures we cover in class. Handouts outlining instructions for the test procedures and reports can be obtained on ELMS.

### Lab Reports

The typed portion of the lab report should be limited to one page or less. Please submit all assignments in electronic format online by midnight on the due date. Although you may consult your textbooks and other resources, including your classmates, as you work on each lab, please make sure your write-up is your own. Three points will automatically be deducted from your lab grade for every day the report is late. The labs will cover the following topics:

Lab #1: Recording parameters	due September 25
Lab #2: ECoChG	due October 2
Lab #3: Two-channel recording	due October 9
Lab #4: Threshold estimation	due October 16
Lab #5: ASSR	due November 6
Lab #6: FFR	due November 20
Lab #8: MLR	due December 4
Lab #7: Cortical	due December 11

### Questions/Difficulties

Please contact me as soon as possible if you have difficulties with or questions about a particular lab assignment, so that they can be resolved in plenty of time for you to complete the lab by the due date, and so that you have a better understanding the relevant concepts prior to exams. If there are any equipment problems or malfunctions, the due dates will be extended.

## Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Please visit <http://apps.gradschool.umd.edu/Catalog/policy.php?the-academic-record> for the Graduate School's full list of campus-wide policies and follow up with me if you have questions.



## **Make-up Exams/Assignments**

If you are aware ahead of time that you will be absent on the day of an exam, you may schedule a make-up exam provided that (1) you have an approved University Acceptance (e.g., religious observance) and (2) I am notified in writing within the first two weeks of the semester. Assignments are expected to be submitted by the dates indicated on the syllabus or in advance of the due date if you anticipate being absent from class on the due date. You should inform me that you will be absent ahead of time to make arrangements to submit the assignment.

When the reason for an absence on the day of an exam or assignment is not foreseeable, you must inform me as soon as possible. Please make every effort to contact me by phone or by email prior to class if you will be absent due to illness or other emergency. Campus Senate policy requires students who are absent due to illness/injury to furnish documentary support to the instructor. You must provide written documentation verifying your illness/injury on the day that you return to class. You will not be allowed to turn in missed assignments or make up exams if you have not provided this documentation. In addition, if it is found that you have falsified the documentation provided, you will be referred to the University's Student Conduct Office.

Make-up exams will be scheduled at a time that is mutually agreeable to both the instructor and the student. Assignments are due immediately by electronic submission if possible or upon the student's return to school. All missed exams and assignments not turned in will result in a grade of zero for that exam/assignment.

## **Problems/Questions**

Please do not hesitate to make an appointment to speak with me if you are having difficulty with the material or with an assignment, if you have questions about how something was graded, or if you have other problems or issues related to the course you wish to discuss. Email is an excellent way to reach me outside of course meetings.

## **Get Some Help!**

You are expected to take personal responsibility for your own learning. This includes acknowledging when your performance does not match your goals and doing something about it. Everyone can benefit from some expert guidance on time management, note taking, and exam preparation, so I encourage you to consider visiting <http://ter.ps/learn> and schedule an appointment with an academic coach. Sharpen your communication skills (and improve your grade) by visiting <http://ter.ps/writing> and schedule an appointment with the campus Writing Center. Finally, if you just need someone to talk to, visit <http://www.counseling.umd.edu>. Everything is free because you have already paid for it, and **everyone needs help...** all you have to do is ask for it.

**Audiology Knowledge and Skills addressed by specific learning outcomes:**



## **Audiology Knowledge and Skills addressed by specific learning outcomes:**

### **3.1.2A FOUNDATIONS OF AUDIOLOGY PRACTICE**

- Embryology, anatomy, and physiology of the auditory, vestibular, and related body systems (Outcomes 1 to 3)
- Normal aspects of auditory and vestibular function across the lifespan (Outcomes 1 to 3)
- Effects and role of genetics in auditory function, diagnosis, and management of hearing loss (Outcomes 1 to 3)

### **3.1.4A ASSESSMENT OF THE STRUCTURE AND FUNCTION OF THE AUDITORY AND VESTIBULAR SYSTEMS**

- Evaluate information from appropriate sources to facilitate assessment planning (Outcomes 2 to 4)
- Obtain a case history (Outcome 2)
- Perform an otoscopic examination (Outcome 2)
- Perform audiologic assessment using behavioral, physiological (e.g., immittance, wideband reflectance, evoked potentials), psychophysical, and self-assessment tools (Outcomes 2 to 4)
- Perform audiologic assessment using techniques that are representative of the challenges listeners may face in everyday communication situations (Outcomes 2 to 4)
- Provide counseling in a culturally sensitive manner to facilitate understanding of the hearing loss, tinnitus, or balance disorder of the individual being served (Outcomes 2 to 4)
- Communicate results and recommendations orally and in writing to the individual being served and other appropriate individual(s) (Outcomes 2 to 4)
- Apply the principles of evidence-based practice (Outcomes 2 to 5)
- Select and use outcomes measures that are valid and reliable indicators of success in assessment protocols that are used (Outcomes 2 to 5)

### **3.1.5A ASSESSMENT OF THE IMPACT OF CHANGES IN THE STRUCTURE AND FUNCTION OF THE AUDITORY AND VESTIBULAR SYSTEMS**

- Administer clinically appropriate and culturally sensitive self-assessment measures of communication function for individuals across the lifespan and the continuum of care (Outcomes 2 to 4)
- Select and use outcomes measures that are valid and reliable indicators of success in determining the impact of changes in structure and function of the auditory and vestibular systems (Outcomes 2 to 5)

### **3.1.6A INTERVENTION TO MINIMIZE THE EFFECTS OF CHANGES IN THE AUDITORY AND VESTIBULAR SYSTEMS ON AN INDIVIDUAL'S ABILITY TO PARTICIPATE IN HIS OR HER ENVIRONMENT**

- Apply the principles of evidence-based practice (Outcomes 2 to 5)