HEARING TESTS AND MEASUREMENT

Educational Psychology 438 (3.0 credits**)**
David L. McPherson, Ph.D. - 129 TLRB
378-6458 (office) - 375-9166 (home)

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Educational Psychology 438 (3.0 credits**) - Fall 1995**
Monday, Wednesday & Friday - 9:00am - 9:50am - 177 TLRB
David L. McPherson, Ph.D.[1] **- 129 TLRB**
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Course Description: This course is required for undergraduate students majoring in Audiology and recommended for students majoring in Speech-Language Pathology. This course meets the American Speech-Language-Hearing Association's (ASHA) certification requirements for course work in assessment and pathologies of the auditory system.

This course presents primary skill development in the administration and interpretation of basic tests of auditory disorders including pure tone air- and bone conduction threshold testing; speech audiometry; fundamentals of middle ear tympanometry; and school and industrial hearing screening. Anatomy and physiology of the normal and pathological auditory system are introduced.

Prerequisites: The following courses are required prerequisites: Educational Psychology 334 and Physics 167. Students that have not completed these prerequisites are required to discontinue this course until such time the prerequisite courses have been completed.

Honor Code: The student is expected to be familiar with the Honor Code. The Honor Code is enforced in this class and students will be required to conform to its principles and practices.. Cheating and plagiarism may result in a class failure, at the discretion of the instructor.

Course Meeting Times: This is a 3 credit course scheduled to meet Mondays, Wednesdays and Fridays. The lecture schedule calls for formal class meetings on Mondays and Wednesdays. The purpose of not holding formal class consistently on Fridays is so that the number of course hours is approximately equal to the course requirements. Because of the laboratory assignments, that the student may generally schedule themselves, time is provided to complete these assignments. This is equal to approximately 12 hours of class time.

Course Objectives

A. To develop a theoretical and practical knowledge of hearing tests and measurements in the field of communicative disorders.

B. To become proficient in the administration of standard audiological testing in adult and children.

C. To understand the role of audiology in auditory and speech-language disorders.

[1]Office hours by appointment only.

D. To gain the fundamentals of gathering case history information and report writing.

Textbooks (required)

1. Katz, J. (ed). Handbook of Clinical Audiology (Fourth edition). Baltimore: William & Wilkins, 1994. [It is highly recommended that this text be purchased and kept for future reference. It will be referred to in other courses and for speech-language majors it is a valuable resource.]

Supplementary Text (not required)

1. Ferrer-Vinent, S. Clinical Masking. Colorado: Susan T. Ferrer-Vinent, 1988.

COURSE REQUIREMENTS[2]

Examinations: There will be two examinations, a midterm (25) pts and a final (30pts). They will be essay or short answer type. Each examination question will have been answered by the instructor prior to actual grading and points assigned. Additional points on each question may be awarded for exceptional answers without penalizing other students. Students are encouraged to meet with the instructor following the midterm examination to discuss each question/answer. Examinations are given as scheduled.

Quizzes: There will be five quizzes worth 4 pts each. These will be similar to the explanations given above for the midterm and final examination. Quizzes are given as scheduled.

Course Participation: The student is expected to be prepared. This includes having read the material prior to class. Students that are not prepared may be penalized one point for each class period. Absence from class is considered unprepared except for medical purposes.

Laboratory Assignments: There will be five laboratory assignments each weighted to 2% of your grade. These will be practical experiences in audiometric assessment. The audiometers may be checked out from the secretary. Speech audiometry will not be required because of the limited space in the audiological testig suites.

[2]All assignments must be typewritten unless otherwise noted. If computer generated an easily readable font must be used. Originals and copies must be clear with dark print. Unless otherwise noted all assignments are due by the beginning of the class period (9:10 am) on the due date. Penalties are assigned for late assignments which amount to 20% of the total earned for that assignment.

Lab Assignment no.	Topic	Due
1	Three pure tone air conduction audiograms (no maksing required)	Oct 30
2	Three pure tone air- and bone-conduction audiograms (proper masking required)	Nov 27
3	Three impedance evaluations (tympanometry, acoustic reflex) along with the pure tone audiogram (air- and bone conduction with appropriate masking)	Dec 6
4	One pediatric (3-5 year old) audiometrics with tympanometry	Dec 13
5	One complete work-up with history	Dec 13

Observations: There will be five observation assignments. Each observation is worth 1 point. The observations will be of various audiological procedures or other experiences deemed valuable by the instructor. It is the responsibility of the student to schedule the observation with the clinic coordinator. Observations may be done at any facility as long as the student is observing an ASHA certified Audiologist or student under the direction of an ASHA certified Audiologist. The supervisor MUST sign the observation sheet (see attachemet)

Observation	Type	Due
1	Audiological Evaluation (Adult)	On or before Dec 11
2	Audiological Evaluation (Adult)	On or before Dec 11
3	Audiological Evaluation (Pediatric)	On or before Dec 11
4	Audiological Evaluation (Pediatric)	On or before Dec 11
5	Hearing Aid Evaluation	On or before Dec 11

Term Paper: Each student will be required to submit an eight to ten page term paper that will be weighted to 10% of the final grade (i.e., 10 points). It will be typed

according to the American Psychological Association's style manual (available at the bookstore/library), include references and double spaced. Since you are entering a profession where timeliness is of the essence in patient care, late papers will not be accepted. APA style will be required.

Suggested topics for term papers: The topic for term papers must be approved by the instructor.[3] The following are suggested topics, but are not all inclusive.

Age related hearing loss on the effects of speech production
Behavioral development of the auditory system
Disease factors causing hearing loss
Effects of aging on hearing
Effects of hearing loss on language development
Genetic hearing loss
Hearing loss in infancy
Localization and hearing
Neurologic insults on hearing
Noise induced hearing loss
Ototoxic hearing loss
Speech communication in noise
The effects of the classroom environment on the hearing impaired

Assignment	Points	Due Date
Topic Approval	1	Oct 2
Outline including Bibliography	1	Oct 30
Draft due	3	Nov 8
Final Term Paper due	5	Nov 27

MULTI-STAKE FIRESIDES, DEVOTIONALS, AND FORUMS

The student may earn 2.0 additional points for attending five of the above functions. A simple statement of attendance (handwritten) may be submitted. IT IS REQUIRED THAT THE STUDENT BE IN ACTUAL ATTENDANCE (viewing or listening to live or recorded broadcasts is NOT acceptable.

Grading Standard: Each of the above areas will be weighted for a total of 100 points. Cheating results in class failure. The distribution is accordingly:

Final examination	30 pts
Midterm examination	25 pts
Five Quizzes	20 pts
Five observations	5 pts

[3]It is your responsibility to make an appointment with the instructor to discuss the topic and get approval for the term paper topic. The topics must be approved by the due date.

Five laboratory assignments	10 pts
Term paper	10 pts
TOTAL[4]	100 pts

A	96-100 pts	C+	78-80 pts
A-	92-95 pts	C	75-77 pts
B+	88-91 pts	C-	70-74 pts
B	84-87 pts	D	65-69 pts
B-	81-83 pts	E	64 & below

[4]Two additional points may be earned for attending Multi-Stake Firesides, Devotional and Forums (see section).

COURSE SCHEDULE AND OUTLINE

HEARING TESTS AND MEASUREMENT

Educational Psychology 438

Class Number	Date of Class	Lecture topic	Assignments[5]	Comments
1	**Sep 6**	Class Syllabus Distributed (no lecture)		
2	**Sep 8**	Orientation to Class and Clinic		**FRIDAY CLASS**
3	**Sep 11**	The Audiogram and Audiometer		Equipment orientation
4	**Sep 13**	The Tympanogram and Admittance Meter		Equipment orientation
		Introduction to Audiology	Katz: Chapter 1	
5	**Sep 18**	Otologic and Neurologic Disorders of Hearing: Part I	Katz: Chapters 2, 3 & 4	
6	**Sep 20**	a. Otologic and Neurologic Disorders of Hearing: Part II b. Otologic Inspection and Case History	Katz: Chapters 2, 3 & 4	
7	**Sep 25**	Psychoacoustics for Audiology	Katz Chapter 5	
8	**Sep 27**	Fundamentals of Pureton testing I: Pediatric techniques (basic techniques)	Katz Chapter 7	Quiz 1
9	**Oct 2**	Fundamentals of Pureton testing II	Katz Chapter 7	Term paper topic approval due
10	**Oct 4**	Theory of bone conduction I	Katz Chapter 8 & 9	
11	**Oct 9**	Theory of bone conduction II	Katz Chapter 8 & 9	
12	**Oct 11**	a. Pure tone bone conduction testing b. Masking I: Theory of clinical masking	Katz Chapter 8 & 9	Quiz 2
13	**Oct 16**	Masking II: Masking of air conduction pure tone testing	Katz Chapter 8 & 9	
14	**Oct 18**	Masking III: Masking of bone conduction pure tone testing	Katz Chapter 8 & 9	
15	**Oct 20**	Masking IV: Masking Problems	Katz Chapter 8 & 9	a. **FRIDAY CLASS**
16	**Oct 23**	**MID TERM EXAMINATION**		MID TERM EXAMINATION
	Oct 25	**NO CLASS**		NO CLASS
17	**Oct 30**	Immittance Audiometry I: Theory of Immitance audiometry and tympanometry	Katz Chapters 19, 20, 21	a. Lab 1 due b. Term paper outline and bibliography due

[5]Reading assignments are to be completed prior to the beginning of the class period.

COURSE SCHEDULE AND OUTLINE, cont'd

HEARING TESTS AND MEASUREMENT

Educational Psychology 438

Class Number	Date of Class	Lecture topic	Assignments	Comments
18	**Nov 1**	Immittance Audiometry II: Theory of Immitance audiometry and tympanometry b. Immittance Audiometry III: Acoustic reflex tesing	Katz Chapters 19, 20, 21	
19	**Nov 3**	Speech testing I: Introduction to speech audiometry.	Katz Chapter 10	a. **FRIDAY CLASS** b. Quiz 3
20	**Nov 6**	Speech testing II: Speech audiometry (threshold testing)	Katz Chapter 10	
21	**Nov 8**	Speech testing III: Speech audiometry (discrimination, masking)	Katz Chapter 10	Term paper DRAFT due
22	**Nov 13**	Auditory Evoked Potentials	Katz Chapters 22 through 27	Know what they are, but not required to know the testing procedures. Use study questions to quide reading.
23	**Nov 15**	Otoacoustic Emissions	Katz: Chapter 29	Know what they are, but not required to know the testing procedures. Use study questions to quide reading.
24	**Nov 20**	Tests of Cochlear function	Katz Chapters 11, 12, 13, 28	Know what they are, but not required to know the testing procedures.
25	**Nov 22**	Disorders of the Central Auditory System	Katz Chapters 14 thourgh 18	a. Know what they are, but not required to know the testing procedures. b. Quiz 4
26	**Nov 27**	Aural Rehabilitation and Hearing Aids I: Hearing Aids	Katz Chapters 38 through 49	a. Lab 2 due b. Term Paper due
27	**Nov 29**	Aural Rehabilitation and Hearing Aids II: Senory Aids	Katz Chapters 38 through 49	
28	**Dec 4**	Special populations (pediatrics, geriatrics, special needs)	Katz Chapters 30, 31, 33, 34, 39	
29	**Dec 6**	Hearing screening and needs in the community	Katz Chapter 35	Lab 3 due
30	**Dec 11**	ASHA Guidelines in Audiology		a. Quiz 5 b. All observations due
	Dec 13	Decision making in Audiology and Report writing		a. No papers accepted after (9:50 am). b. Labs 4 and 5 due
	Dec 19	Final Examination 7:00am-10:00am	Room 177 TLRB	

SAMPLE CLINICAL OBSERVATION

CLINICAL OBSERVATION #1

(*Student name)*
(Course)
(Date)

Clinician's name: Dr. Carey
Procedure: Audiometric evaluation

Brief History

This is a 35 year old female with progressive hearing loss over the past three years. Additional significant history includes multiple sclerosis.

Tests Observed

1. Pure tone air and bone conduction threshold
2. Speech reception and speech discrimination testing
3. Tympanometry
4. Post-evaluation counseling

Evaluation

A pure tone air and bone conduction audiogram were completed indicating a bilateral sensorineural hearing loss. Speech reception thresholds were completed. Of particular interest were the extremely low speech discrimination scores (20%).

Comments

It did not appear that the patient was very cooperative during the test. Perhaps the instructions could have been better explained. I would have done acoustic reflex testing.

SAMPLE UNIT ESSAY

UNIT ESSAY #1

(*Student name)*
(Course)
(Date)

Journal article: Shamma SA. Sterausis: Binaural processing without neural delays. J Acous Soc Am., 86, 3, 989-1006, 1989.

A model of binaural processing was proposed which discussed both a temporal and spatial model of binaural hearing. The model accounted for both low and high frequency tones. Interaural time differences of .....

Note: If observations or other topics are chosen this should be stated where 'Journal article' is located with a brief description of the topic (i.e., Observation: Assisting Dr. Harris in making noise measurements of a BYU basketball game).

UNIT ESSAY #2

(sample of general essay)

(*Student name)*
(Course)
(Date)
Topic: Compression amplifications in hearing aid use.

The use of compression amplification in hearing aid use was one of the first improvements in hearing aids during the 1970s. Prior to its use maximum output was controlled by peak clipping that severely distorted the amplified signal. Compression amplification enabled the clinician to limit the maximum power output of the hearing aid without such distortion. In addition.....

SAMPLE LABORATORY ASSIGNMENT

LABORATORY ASSIGNMENT #1

(*Student name)*
(Course)
(Date)

Laboratory Assignment: Pure tone audiogram

Pure tone audiograms (three) were completed on other students that were reported to have normal hearing. A portable audiometer (Belltone 10C) was used. The testing was done in a quiet room. Both air and bone conduction audiograms were constructed from the results.

Note: The student must attach copies of each audiogram and/or other forms (stapled) to the cover sheet.

SAMPLE CASE HISTORY AND REPORT

AUDIOLOGIC EVALUATION

(*Student name)*
(Course)
(Date)

Patient Name: Clyde Gates
Date of Birth: 15 June 1956
Sex: Male Age: 35 years

Date of Evaluation: December 7, 1991

Complaint

The patient reported that he was unable to hear people when he was in a noisy situation and his wife complained the television was too loud. Also it was stated that he had a 'hissing' in his ears at times that sounded like 'a steam valve was broken.' He noted that although he can 'hear' people it is difficult to understand what they are saying.

Background

The patient has a negative history for familial hearing loss, acute illnesses resulting in fevers or the use of antibiotics, and states he is in general good health. The patient is employed as a pipe fitter and works in a situation that he described as 'high' noise level. The patient reported no significant history of high blood pressure, cardiac disease and is a non-smoker. The patient uses alcohol on social occasions. The patient enjoys SCUBA diving and reports frequent ear infections. He also reported having difficulty clearing his ears on moderate to deep dives. The patient reported he did not experience any dizziness or gait problems.

Clinical Observation

Speech and language appear normal for age and social conditions. No phonemic regression was noted. The patient understood all of my questions when facing him, but on a couple of occasions had difficulty understanding me if my face was turned in a different direction. It is my impression he relays on speech reading to supplement his auditory cures.

Evaluation

[A description of the tests/evaluation used would be placed in narrative with a summary description of the results. For example]:

Pure tone air and bone conduction threshold under appropriate masking procedures suggest a 50 dB loss in the low-to-mid- frequencies sloping to a severe loss in the mid-to-high frequencies (70-90 dB), with an air-bone gap in the 250-2000 Hz range.

Speech reception thresholds were consistent with the pure tone audiogram. Speech discrimination, in quiet, showed 66% on the right and 48% on the left.

Tympanometry showed reduced compliance, bilaterally. The acoustic reflex could not be elicited except in the right ear at 4000 Hz using maximum intensity (110 dB SPL).

Impression

A true estimate of residual hearing abilities in this patient could not be established because of possible middle ear involvement as noted by the abnormal tympanograms, bilaterally. However, it is my guess that there is probably a moderate-to-severe hearing loss present. The history would indicate the presence of tinnitus. Although the actual etiology cannot be established this patient's profile is typical of noise induced permanent hearing loss and/or barotrauma.

Recommendations

1. Medical referral for both possible intervention and hearing aid clearance.
2. Repeat threshold testing following medical intervention.
3. Tinnitus evaluation.
4. Speech testing in noise to establish functional hearing abilities.
5. Counseling as to ear defenders and the use of such.
6. Hearing aid evaluation.
7. Communicative strategy counselling with the spouse.

The patient was counselled as to the above recommendations and has agreed to follow-up. I would very much like receiving copies of any reports and will be responsible for the audiological management of this patient.

(Signature)
David L. McPherson, Ph.D.

attachments: Audiogram, tympanograms
cc: Chart files

SAMPLE ESSAY EXAM QUESTION

Blue books, using double spacing, are to be used in all examinations <u>except</u> for 'take home' examinations that are to be typewritten, double spaced.

(*Student name)*
(Course)
(Date)

Exam question: Describe and characterize the measures used in the auditory brainstem evoked potential recording and their relationship to stimulus intensity.

Response: The auditory brainstem evoked potential may be described as a biphasic waveform with quantitative properties of amplitude and latency. In addition a qualitative feature may be described in terms of its morphology.

Amplitude may either be described in voltage, usually microvolts, from the baseline to corresponding peak, or from positive peak to corresponding negative peak. As stimulus intensity increase, the amplitude of the response increases. The converse is also true. The first amplitude changes from baseline, in ideal recording conditions, may be seen as early as 10 dB above behavioral threshold for the stimulus; especially sharply rising (i.e., clicks) stimuli.

Latency is defined as the time, in milliseconds, from the onset of the stimulus to a peak. For consistency, wave V, which may be broad, is defined as the breaking point, or departure point, from the linear descending slope. Latency decreases as stimulus intensity increases. The converse is also true.

It should be noted that there is a point where both amplitude and latency asymptote.

In formulating this question one point is awarded for each correct identification and discussion of the pertinent areas:

1. Description of amplitude
2. Description of latency
3. Description of morphology
4. Use of microvolts
5. Use of milliseconds
6. Relationship of amplitude to intensity
7. Relationship of latency to intensity
8. Statement of how amplitude is measured
9. Statement of how latency is measured
10. Relationship of amplitude and latency to morphological features

It should be noted that areas 1, 2, 4, 5, 6, 7 and 8 were covered providing 7 points for this answer. However additional discussions in some areas were significant enough that extra points were awarded:

1. Acknowledging that the response is biphasic.
2. Amplitude may be measured using one of two references.
3. Amplitude of a wave may first appear at about 10 dB SL.

Consequently, an additional three points are awarded for this question providing a total of 10 points. Such additional points are solely at the discretion of the instructor. Since a grading curve is not used, other students are not penalized.