

## PSYC W3265 Auditory Perception Fall 2009

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### Introduction

How does the human brain make sense of the acoustic world? What properties of sound are important for the discrimination and recognition of sounds with specific meaning? What aspects of auditory perception do humans share with other animals? How does the brain perform the computations necessary for skills such as sound localization? How do we focus our auditory attention on one voice in a crowd? What acoustic cues are important for speech perception? What's special about music? We will address these questions and more by studying the basics of auditory perception in a textbook, and reading classic and current literature to understand the scientific progress in the field today. Our reading of the literature will be critical, with a focus on good scientific design.

This course will systematically review the main topics of auditory perception such as: 1) the physics of sound; 2) the anatomy and physiological functioning of the auditory system; 3) perception of loudness; 4) frequency selectivity and discrimination; 5) perceptual phenomena such as forward and backward masking; 6) temporal processing; 7) pitch and timbre perception in simple and complex sounds; 8) auditory attention; 9) scene analysis; 10) speech and music perception. We will examine the current literature on such topics as sound localization in humans and other animals, how the brain forms a map of auditory space, acoustic communication in humans, birds and other mammals, and how the brain may be specialized to encode the unique communication sounds of individual species. We will analyze the studies demonstrating categorical perception and lateralization of the brain for language processing. And we will study how people perceive and process music.

### Course requirements

Professor Woolley's permission to join the class is **required**. Attendance at the first day of class is **required**. Each week, students will participate in a two-hour seminar. Class time will be devoted to the presentation and discussion of journal articles. The textbook reading is intended to provide background knowledge on the relevant topics. The publications have been chosen to cover the current and most exciting research on auditory perception, and to serve as a stimulus for discussion. Two students sign up to lead the discussion each week.

### The reading list and weekly schedule

**Textbook:** Yost, W (2006) Fundamentals of Hearing. (5<sup>th</sup> edition)

### **Week 1 – Sept 14**

The physical properties of sound, the ear, the auditory system, functions of hearing, model systems in understanding auditory perception

**Relevant textbook chapters:** 1, 2, 3, 6, 7 and 8

Students select presentation topics this week

### **Week 2 – Sept 21**

Sound Intensity and Loudness Perception

**Presenters:**

**Relevant textbook chapters:** 9 – 11, 13, 15

Hellman, R, Miskiewicz, A, Scharf, B (1997) Loudness adaptation and excitation patterns: Effects of frequency and level. *JASA* **101**:2176-2185.

Dean, I, Harper, NS, McAlpine, D (2005) Neural population coding of sound level adapts to stimulus statistics. *Nature Neurosci* **8**:1684-1689.

### **Week 3 – Sept 28**

Processing Frequency and Temporal Information

**Presenters:**

**Relevant textbook chapters:** 4, 5, 15

**Reading only:** Irvine, D, Wright, BA (2005) Plasticity of Spectral Processing. *Int Rev Neurobiol* **70**: 435-72

Bent, T, Bradlow, AR, Wright, BA (2006) The influence of linguistic experience on the cognitive processing of pitch in speech and nonspeech sounds. *J Exp Psychol Hum Percept Perform* **32**: 97-103.

Lu, T, Liang, L, Wang, X (2001) Temporal and rate representations of time-varying signals in the auditory cortex of awake primates. *Nature Neurosci* **4**:1131-1138

Bendor, D, Wang, X (2005) The neuronal representation of pitch in primate auditory cortex. *Nature* **436**: 1161-1165.

#### **Week 4 – Oct 5**

##### Sound Localization

##### **Presenters:**

**Relevant textbook chapters:** 12, 15

**Reading only:** Konishi, M (2003) Coding of auditory space. *Annu Rev Neurosci* **26**:31-55.

Knudsen, EI, Konishi, M (1978) A neural map of auditory space in the owl. *Science* **200**: 795-7.

Bergan, JF, Ro, P, Ro, D, Knudsen, EI (2005) Hunting increases adaptive auditory map plasticity in adult barn owls. *J Neurosci* **25**: 9816-9820.

McAlpine, D (2005) Creating a sense of auditory space. *J Physiol* **566**: 21-28.

#### **Week 5 – Oct 12**

##### Auditory Attention

##### **Presenters:**

**Relevant textbook chapters:** 14

Carlyon, RP (2004) How the brain separates sounds. *Trends Cog Sci* **8**:465-471.

Alain, C, Arnott, SR (2000) Selectively attending to auditory objects. *Front Biosci* **5**: D202-12.

Cardin, J, Schmidt, M (2003) Song system auditory responses are stable and highly tuned during sedation, rapidly modulated and unselective during wakefulness and suppressed by arousal. *J Neurophys* **90**: 2884-99.

#### **Week 6 – Oct 19**

No meeting Annual Society for Neuroscience Meeting

#### **Week 7 – Oct 26**

## Complex Sounds, Streaming and Scene Analysis

**Presenters:**

**Relevant textbook chapters:** 11, 14, 15

**Reading only:** DeWeese, MR, Zador, AM (2005) Neural Gallops across Auditory Streams. *Neuron* **48**: 5-7.

Micheyl, C, Tian, B, Carlyon, RP, Rauschecker, JP (2005) Perceptual Organization of Tone Sequences in the Auditory Cortex of Awake Macaques. *Neuron* **48**:139-148.

Gutschalk, A, Micheyl, C, Melcher, JR, Rupp, A, Scherg, M, Oxenham, AJ (2005) Neuromagnetic Correlates of Streaming in Human Auditory Cortex. *J Neurosci* **25**:5382-5388.

### Week 8 – Nov 2

Academic holiday

### Week 9 – Nov 9

Midterm Exam

### Week 10 – Nov 16

Speech Perception

**Presenters:**

**Relevant textbook chapters:** 14

**Reading only:** Diehl, RL, Lotto, AJ, Holt, LL. (2004) Speech Perception. *Ann Rev Psychol* **55**: 149-79.

Kuhl, PK, Williams, KA, Lacerda, F, Stevens, KN and Lindblom, B (1992) Linguistic experience alters phonetic perception in infants by 6 months of age. *Science* **255**: 606-608.

TBA

TBA

### Week 11 – Nov 23

## Neural Basis of Speech Perception

Presenters:

**Relevant textbook chapters:** 14, 15, 16

Golestani, N, Paus, T, Zatorre, RJ. (2002) Anatomical Correlates of Learning Novel Speech Sounds. *Neuron* **35**:997-1010.

Dehaene-Lambertz, G, Hertz-Pannier, L Dubois, J (2006) Nature and nurture in language acquisition: anatomical and functional brain imaging studies in infants. *Trends Neurosci* **29**: 367-373.

**Reading only:** Marcus, GF (2006) Language: startling starlings. *Nature* **440**: 1117-8.

Gentner, TQ, et al. (2006) Recursive syntactic pattern learning by songbirds. *Nature* **440**: 1204-7.

## Week 12 – Nov 30

### Auditory communication in nonhuman animals

Presenters:

**Relevant textbook chapters:** 15

**Reading only:** Doupe, AJ, and Kuhl, PK (1999) Birdsong and human speech: common themes and mechanisms. *Annu Rev Neurosci* **22**: 567-631.

Poulet, JFA, Hedwig, B (2005) Auditory orientation in crickets: pattern recognition controls reactive steering. *PNAS* **102**: 15665-69.

Egnor, SER, Iguina, CG, Hauser, MD (2006) Perturbation of auditory feedback causes systematic perturbation in vocal structure in adult cotton-top tamarins. *J Exp Biol* **209**: 3652-63.

TBA

## Week 13 – Dec 7

### Music Perception

Presenters:

**Relevant textbook chapters:** 14, 15

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McDermott, J, Hauser, MD (2007) Nonhuman primates prefer slow tempos but dislike music overall. *Cognition* **104**: 654-68.

### **Week 14 – Dec 14**

#### Neural Basis of Music Perception

**Presenters:**

**Relevant textbook chapters:** 14, 15

**Read only:** Peretz, I, Zatorre, R (2005) Brain organization for music processing. *Ann Rev Psychol* **56**: 89-114.

Tervaniemi, M (2001) Musical Sound Processing in the Human Brain: Evidence from Electric and Magnetic Recordings. *Ann N Y Acad Sci* **930**:259-272.

Zatorre, RJ, Halpern, AR (2005) Mental Concerts: Musical Imagery and Auditory Cortex. *Neuron* **47**:9-12.

**THERE IS NO FINAL EXAM**

### **Grading**

The students take a written midterm exam with essay questions covering the material in the textbook, the papers and the class discussions.	25%
Presentations	50%

Participation	25%
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