Music 175: Psychoacoustics
Spring 2020

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Course Information

Teaching Assistant

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Meeting Time and Place

Meeting Dates: 2020/3/31 - 2020/6/8

	Time
Lecture:	TuTh 12:30PM -1:50PM via Zoom
Office hour:	Th 2:00-300PM, or by appointment (Smyth/Zurale)
Final presentations	M 11:30AM-2:30PM, 6/8/2020 (scheduled final exam)

COVID 19: Spring 2020 will be available BOTH synchronously and asynchronously.

Course Description

Survey of psychoacoustical phenomena, theories of hearing, and their relation to musical perception and cognition. Techniques of psychoacoustical experimentation.

Prerequisites

Music 170 or 171 (or permission by instructor).

Grading

- Quizzes (3 X 15% each): 45%
- Selected paper presentation: 15%
- Assignments/Discussions: 20%
- Final project 20%

Required Textbooks

- Perry R Cook (editor). Music, Cognition, and Computerized Sound: An Introduction to Psychoacoustics (available on campus here, off campus through https://vpn.ucsd.edu)
- Brian Moore. An Introduction to the Psychology of Hearing (available here).
- Music 175 on-line notes.

Quizzes

Quizzes will be available on Canvas and will based on lectures, assigned readings, and student presentations.

Important Dates

- **Thursday, April 9, 2020**: Paper sign-up;
- **Tuesday, April 21, 2020**: Quiz 1;
- **Thursday, May 7, 2020**: Project proposals;
- **Thursday, May 14, 2020**: Quiz 2;
- **Thursday, June 4, 2020**: Quiz 3;
- **Monday June 8, 2020, 11:30AM-2:30PM**: Final project presentations;

Schedule and Online Lecture Notes (subject to change)

- Week 1:
  - Introduction to Music 175
  - **Sound**:
    - Sound: what is sound? acoustics vs. psychoacoustics.

    - Waves: time representation of sound, sinusoids, partials/overtones, harmonics.
    - Spectrum: frequency representation of sound, fourier analysis, spectrograms, periodicity
  - **Pd patches**: harmonicity.pd, pitchFreq.pd, pitchFreq.pd.
  - **Reading**: Cook, Chapter 4.

- Week 2:
  - **Hearing**
    - Sound Level: pressure, power, intensity, dB scale
    - Ear Physiology: The ear and how it works
    - Loudness: phons, sones, Fletcher-Munson equal loudness curves, masking
  - **Pd patches**: db.pd, FrequencyAndLoudness.pd, max.pd.
  - **Reading**: Cook, Chapter 1 and 6.

- Week 3:
  - **Hearing in Time and Space**
    - Time and Space: "cocktail party effect", binaural masking, precedence effect, reverberation, localization.
  - **Reading**: Cook, Chapter 8.

- Week 4:
  - **Hearing in Time and Space (cont.)**
  - Field trip: Audio Spatialization Lab (Spat Lab), Calit2 (cancelled, COVID 19).
    - Spat Lab map (see room in yellow, 1604A)
  - **Quiz 1: Tuesday April 21, 2020** (last 45 mins of class)
  - **Student paper presentations** Hearing in Time and Space
    - studentname: "A General Model for Spatial Processing of Sounds"
    - sudentname: "Comparative Study of European Concert Halls"
    - studentname: "Synchronization in Performed Ensemble Music"

- Week 5:
  - **Student paper presentations** Hearing in Time and Space
    - studentname: "Monaural Detection of Phase Difference Between Clicks"
    - studentname: "The CIPIC HRTF Database"
    - studentname: "Discriminability of Time-Reversed Pairs of Clicks"

    - studentname: "The effects of neighborhood views containing multiple environmental features on road traffic noise perception at dwellings"
  - **Cognitive Psychology and Music**
    - Principles of perception: unconscious inference vs. direct perception (Gibson), size and loudness constancy, perceptual completion, gestalt grouping principles.
  - **Reading**: Cook, chapter 3
- Week 6:
  - **Timbre**
    - Timbre: average spectral shape, formants, missing harmonics, time variation.
  - **Reading**: Cook chapter 7.
  - **Student paper presentations** Timbre/Signal Discrimination
    - studentname: "Multidimensional Perceptual Scaling of Musical Timbres"
    - studentname: "Timbre Space as a Musical Control Structure"
    - studentname: "Discrimination of Transient Signals Having Identical Energy Spectra."
    - studentname: "Squeezing speech into the deaf ear."
    - studentname: "Auditory Illusions and Confusions"
    - studentname: "Hearing Lips and Seeing Voices"
- Week 7:
  - **Ambiguity in Music**
    - Auditory Streaming: ambiguity, common fate, separation with apparent motion, Shepard tones, tritone paradox
  - **Quiz 2: May 14, 2020** (Thursday, last 45 minutes)
  - **Reading**: Cook chapter 10.
- Week 8:
  - **Pitch**
    - Pitch Perception: place theory of pitch, repetition pitch, pitch paradox, jnd, mel scale
  - **Reading**: Cook, chapter 5
  - **Student paper presentations** Pitch (Perception)
    - studentname: "Periodicity and Pitch Perception."
    - studentname: "Circularity in Judgments of Relative Pitch."

    - studentname: "Octave Generalization and Tune Recognition."
    - studentname: "The Tritone Paradox: Correlate with the Listener's Vocal Range for Speech"

- Week 9:
  - **Pitch cont.**
    - Pitch 2: jnd, mels scale, pitch spaces
    - Consonance: scales, periodicity, intervals, beating, Rameau and inversions, pitch errors in scales, cents
  - **Reading**: Cook chapter 13 and 14
  - **Student paper presentations** Pitch (Consonance)
    - studentname "Harmony and Nonharmonic Partials."
    - studentname "Beat Theories of Musical Consonance."
    - studentname "Tonal Consonance and Critical Bandwidtch"
    - studentname "Attaining Consonance in Arbitrary Scales."
  - **Student paper presentations** Pitch (Scales)
    - studentname: "Interval-Class Content in Equally Tempered Pitch-Class Sets: Common Scales Exhibit Optimum Tonal Consonance."
    - studentname: "Local Consonance and the Relationship Between Timbre and Scale."
    - studentname: "Theoretical and Experimental Exploration of the Bohlen–Pierce Scale."
    - studentname: "More than Just Notes: Psychoacoustics and Composition"
    - studentname "Calculation of the acoustical properties of triadic harmonies."

- Week 10:
  - **Student paper presentations** Bioacoustics (Animal Hearing/Perception)
    - studentname: "Bat echolocation calls facilitate social communication"
    - studentname: "Extremely high frequency sensitivity in a 'simple' ear" (Hearing in moths)
    - studentname: "Hearing in the Elephant: Absolute Sensitivity, Frequency Discrimination, and Sound Localization"
    - studentname: "Fin Whale Sound Reception Mechanisms"
  - **Quiz 3: June 4 2020** (last 45 minutes)

Assignments

Assignment are to be submitted on CANVAS by 12:30PM (**b**efore class) on the day they are due.

- Week 1:
  - **Due Tuesday April 7, 2020**.
  - Download Pd
  - A1
  - Reading: Cook, chapter 4.
- Week 2:
  - **Due Tuesday April 14, 2020**.
  - Download harmonicity2.pd
  - A2
  - Reading: Cook, chapter 1 and 6.
- Week 3:
  - **Due April 21, 2020**
  - Download frequencyAndLoudness.pd.
  - A3
  - Reading: Cook, chapter 8.
- Week 4:
  - **Due April 28, 2020**
  - A4 (to be posted)
  - Reading: Cook, chapter 3.
- Week 5:
  - Reading: Cook, chapter 7.
- Week 6:
  - **Final project proposal**: write a brief (1-2 paragraph) proposal describing your project and submit on CANVAS. Once you receive approval from the TA, you may begin working on your project.

Selected Paper Presentation

- Select a paper from the list below (additional paper suggestions are welcome, but should be approved by the instructor);
- Prepare a 10-minute paper presentation for the class;
- Sign up (on Canvas) **by the end of the second week**.
- A precise date will be assigned after the second week, however an approximate date can be found in the Schedule.

Hearing in Time and Space

1. Moore, F. R. (1983). "A General Model for Spatial Processing of Sounds." Computer Music Journal (Autumn), 6-15. (available electronically from UCSD library).
2. Rasch, R. A. (1979). "Synchronization in Performed Ensemble Music." Acustica, 43, 121-131. (harder)
3. Resnick, S. B., and Feth, L. L. (1975). "Discriminability of Time-Reversed Pairs of Clicks." Journal of the Acoustical Society of America, 57, 1493–1499.
4. Ronkin, D. A. (1970). "Monaural Detection of Phase Difference Between Clicks." Journal of the Acoustical Society of America, 47, 1091-1099. (harder)
5. Schroeder, M. R., D. Gottlob, and K. F. Siebrasse (1974). "Comparative Study of European Concert Halls, Correlation of Subjective Preference with Geometric and Acoustic Parameters." Journal of the Acoustical Society of America, 56, 1195-1201.
6. Algazi, V. R., R.O.Duda, and D.M.Thompson (2001). "The CIPIC HRTF Database." IEEE Workshop on Applications of Signal Processing to Audio and Acoustics 2001, New Paltz, NY. PDF
7. T.M.Leung et al. (2017). "The effects of neighborhood views containing multiple environmental features on road traffic noise perception at dwellings", Journal of the Acoustical Society of America, 141, 2399-2407, http://asa.scitation.org/doi/full/10.1121/1.4979336 (student suggestion)

Timbre/Signal Discrimination

8. Grey, J. M. (1976). "Multidimensional Perceptual Scaling of Musical Timbres." Journal of the Acoustical Society of America, 61(5): 1270-1277.
9. Wessel, D. L. (1979). "Timbre Space as a Musical Control Structure." Computer Music Journal, 3(2): 45-52.

10. Patterson, J. H., and D. M. Green. (1970). "Discrimination of Transient Signals Having Identical Energy Spectra." Journal of the Acoustical Society of America, 48, 121–131.

11. Gregory, R. L. and A. E. Drysdale (1976). "Squeezing speech into the deaf ear." Nature, 264, 748 - 751.

12. Warren, R. M., and R. P. Warren (1970). "Auditory Illusions and Confusions." Scientific American, 233, 30-36.

13. McGurk, H., and J. MacDonald (1976). "Hearing Lips and Seeing Voices." Nature, 264, 746 - 748.

Pitch (Perception)

14. Pierce, J. R. (1991). "Periodicity and Pitch Perception." Journal of the Acoustical Society of America, 90, 1889-1893.

15. Shepard, R. N. (1964). "Circularity in Judgments of Relative Pitch." Journal of the Acoustical Society of America, 35, 2346-2353.

16. Deutsch, D. (1972). "Octave Generalization and Tune Recognition." Perception and Psychophysics, 11, 411-412.

17. Deutsch, D., North T., and R Lee (1990). "The Tritone Paradox: Correlate with the Listener's Vocal Range for Speech". Music Perception, 1990, (7), 371-384.

Pitch (Consonance)

18. Mathews, M. V., and J. R. Pierce. (1980). "Harmony and Nonharmonic Partials." Journal of the Acoustical Society of America, 68, 1252-1257.

19. Nordmark, J., and Fahlen, L. (1988). "Beat Theories of Musical Consonance." In Speech Transmission Laboratory, Quarterly Progress and Status Report. Dept. of Speech Communication and Music Acoustics, Royal Institute of Technology, Stockholm.

20. Plomp, R., and Levelt, W. J. M. (1965). "Tonal Consonance and Critical Bandwidth". Journal of the Acoustical Society of America, 38, 548-560.

21. Pierce, J. R. (1966). "Attaining Consonance in Arbitrary Scales." Journal of the Acoustical Society of America, 40, 249.

Pitch (Scales)

22. Huron, D. (1994). "Interval-Class Content in Equally Tempered Pitch-Class Sets: Common Scales Exhibit Optimum Tonal Consonance." Music Perception 11(3), 289-305.

23. Sethares, W. A. (1993). "Local Consonance and the Relationship Between Timbre and Scale." Journal of the Acoustical Society of America, 94, 1218-1228.

24. Mathews, M. V., J. R. Pierce, A. Reeves, and L. A. Roberts. (1988). "Theoretical and Experimental Exploration of the Bohlen–Pierce Scale." Journal of the Acoustical Society of America, 84, 1214-1222.

25. Robert HP Platz (translated by Frances Wharton) (1993). "More than Just Notes: Psychoacoustics and Composition", *Leonardo Music Journal*, Vol. 5, 1995, pp. 23-28. (student suggestion)

26. Cook N. D. (2017). "Calculation of the acoustical properties of triadic harmonies." Journal of the Acoustical Society of America, 142 (6), 3748-3755. (student suggestion)

Bioacoustics (Animal Hearing/Perception)

27. Hannah M. Moir, Joseph C. Jackson and James F. C. Windmill. "Extremely high frequency sensitivity in a 'simple' ear" (hearing in moths), available here

28. Rickye S. Heffner and Henry E. Heffner. "Hearing in the Elephant: Absolute Sensitivity, Frequency Discrimination, and Sound Localization", available here

29. Mirjam Knörnschild *et all.* "Bat echolocation calls facilitate social communication", available here.

30. Ted W. Cranford and Petr Krysl (2015). "Fin Whale Sound Reception Mechanisms: Skull Vibration Enables Low-Frequency Hearing", available here (student suggestion)

Final Project

The project includes a **proposal** (a brief 1-2 paragraph description to be approved by TA/instructor), a **presentation** (five minutes during the final exam period) and may consist of:

- research paper (5-10 pages): topic of choice with the following rubric:

    1. **style**: consistently follow a standard research style, e.g. MLA APA, Chicago, etc.;

2. **content**: well written and clear, the information is correct and accurate, and includes at least two scientific sources (citations).

- design a listening experiment in pd + (shorter) paper;
- analyze a musical composition (or create your own) illustrating an auditory effect + (shorter) paper
- other