LING 412: SPEECH PERCEPTION
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CTools Course Site: LING 412 001 W10

COURSE DESCRIPTION
Under typical conversational conditions, humans are highly accurate at recognizing the sounds of speech and at assigning a linguistic interpretation to sequences of speech sounds. Yet the problems that humans encounter in some listening situations—such as the substantial difficulties that language learners can have (even after years of experience) distinguishing between speech sounds in a non-native language—hint at the complexity of perceptual processing. The complexity is also apparent when we consider the difficulties that speech researchers encounter in programming computers to recognize human speech.

This course investigates how listeners extract a linguistic message from the input acoustic stream. The course begins by considering the nature of the acoustic signal, and how systematic acoustic variation structures the signal that serves as input to the listener. We will then turn to experimental work on speech perception that demonstrates that perceptual processing is not a simple one-to-one mapping between acoustic property and linguistic percept, but rather involves "decoding" the acoustics in ways that depend on phonetic context, speaking rate, the listener's native language, sociolinguistic factors, and much more. We will consider as well two dominant theories of speech perception and the main theoretical issues that have driven speech perception research for over 50 years, including the foundational question of whether speech perception differs from other types of auditory processing.

The course also introduces students to the relation between theory and experimentation, and to experimental design, in this cross-disciplinary field. This goal is addressed in two ways. First, we will read and assess the primary literature for a focus topic: the influence of linguistic experience on speech perception. Through this lens, students will get a detailed picture of how specific theoretical questions are translated into an experimental design, and how those results in turn lead to theoretical revisions and/or engender new questions. Second, the course will take a hands-on approach to the experimental study of speech perception. Students will participate in small-scale versions of one or two classic perception experiments in order to better understand the phenomena as well as the experimental methods. In addition, class participants will organize into groups of 4-6 students and each group will design and execute a small-scale experiment that investigates the perceptual consequences of a specific type of linguistic experience. (Advisory prerequisite: Ling 313 or permission of instructor)

READINGS
All readings are posted on the CTools site. Most readings are research articles from the primary literature on speech perception, although background material on acoustic phonetics and acoustic variation is from two textbooks (Raphael et al. 2007, Reetz & Jongman 2008).
Good textbooks for acoustics and perception include:

COURSE REQUIREMENTS
- Active and informed participation in weekly discussions that shows you have read and thought about the readings: 25%
- Small-scale acoustic analysis: 10%
- Two-page critique of an experimental study: 10%
- Timely, collaborative contributions to the group speech perception experiment, including experimental write-up: 30%
- Final paper: 25%

Experiment:
For details, see separate handout "Group Speech Perception Experiments".

Final paper:
The final paper may be (a) a detailed prospectus for an original, theoretically motivated speech perception experiment or (b) a critical assessment, supported by experimental evidence from the literature, of a well-defined theoretical issue in speech perception. Your final paper may, subject to my approval, build on the perception experiment that your group conducted. See page 4, "Final Paper Options", for more details.

COURSE-RELATED TOOLS
1. Course website. The CTools (www.ctools.umich.edu) website for the course will be used for posting readings, announcements, handouts, syllabus updates, copies of lecture notes (only occasionally!—mostly this is a discussion-based course), and more. Students should log on to the website frequently. Please let me know if you have any questions about the site, or run into any difficulties using it.

2. Praat: The acoustic analysis and stimulus presentation program that we'll be using, Praat, is available on the computers in the Linguistics Computer Classroom and is downloadable from http://www.fon.hum.uva.nl/praat/. You will generally have access to the Linguistics Computer Classroom during most hours when classes are not being held in that room. Praat and other phonetics software are also on the Macs in the Phonetics Lab.

PHONETICS LABORATORY
The department has a state-of-the-art phonetics laboratory. For physiologic measures, the lab has a (1) portable ultrasound system for imaging tongue body movement during continuous speech, (2) pneumotachograph for measuring oral and nasal airflow, and (3) electroglottograph for studying laryngeal function. For acoustic and perceptual studies, the lab has high-quality recording equipment, several acoustic analysis packages, Klatt speech synthesis, and software and hardware for running a wide range of perceptual tests. Most data are collected in the sound room in 400 Lorch.
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<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Work due</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/12</td>
<td>Course overview &amp; goals</td>
<td>Expt: select experimental group</td>
<td>Optional: Liberman 1996</td>
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<tr>
<td>1/19</td>
<td>The acoustic structure of speech</td>
<td></td>
<td>Reetz &amp; Jongman (pp. 136-146, 162-200)</td>
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<tr>
<td>1/26</td>
<td>Acoustic cues and acoustic variation</td>
<td>Acoustic analysis of vowels</td>
<td>Raphael et al. 2007 (pp. 213-230); Peterson &amp; Barney 1952</td>
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<td>2/2</td>
<td>Perceiving consonants</td>
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<td>Liberman et al. 1957; Raphael et al. 207 (part 2)</td>
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<td>2/9</td>
<td>Experimental interlude: introduction to group experiment(s)</td>
<td>Expt: determine design and recording materials</td>
<td>(Readings TBD for each exp. group)</td>
</tr>
<tr>
<td>2/16</td>
<td>Perceiving vowels</td>
<td>Expt: submit design write-up for approval</td>
<td>Ladefoged &amp; Broadbent 1957; Strange et al. 1983</td>
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<td>3/9</td>
<td>Perceiving gestures or perceiving acoustic structure? Two theoretical perspectives on perceptual invariants</td>
<td>Two-page critique</td>
<td>Diehl &amp; Kluender 1989; Fowler 1989</td>
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<td>3/23</td>
<td>Experimental interlude: work on class experiment</td>
<td>Expt: conduct test</td>
<td>(None)</td>
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<td>3/30</td>
<td>Perceiving non-native sounds: native-language influences</td>
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<td>Werker &amp; Tees 1981; either Shafer et al. 2004 or Pruitt et al. 2006</td>
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<td>4/6</td>
<td>Perceiving native sounds: lexical influences</td>
<td>Expt: analysis of results</td>
<td>Ganong 1980; Fox 1984</td>
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<td>4/13</td>
<td>Perceiving native sounds: dialectal and sociolinguistic influences</td>
<td>Expt: write-up</td>
<td>Hay et al. 2006; Clopper et al. in press</td>
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<td>4/20</td>
<td>New approaches to long-standing questions: tracking the time course of perception</td>
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<td>(None)</td>
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<td>4/27</td>
<td>Presentation of experimental results; final paper due</td>
<td>Presentation; final paper</td>
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**Option 1: Prospectus for an original, theoretically motivated speech perception experiment**

There is a strong likelihood that, in the course of reading the research articles associated with this course and/or in the course of class discussions, you'll speculate something to the effect of "I wonder what would happen if someone tested ...". This is your opportunity to turn that speculation into a carefully thought out prospectus for a speech perception experiment.

Your paper should consist of the sections typically found in an experimental paper in this discipline except that Results and Discussion sections would be replaced by consideration of possible results and their implications:

- **INTRODUCTION**: The Introduction sets the stage for the proposed experiment. It clearly defines the main research question to be addressed and provides a critical evaluation of the relevant existing literature, ideally situating the research question in relation to issues of importance for theories of speech perception. The Introduction (or sometimes a separate section after Methods but prior to Results) typically also clearly identifies the hypotheses to be tested, the predicted outcomes, and the basis for those predictions.

- **METHODS**: What is the nature of the stimuli that will be presented to listeners? What experimental paradigm (e.g., identification, discrimination, phoneme monitoring) and presentation technique (e.g., reaction time, eye-tracking) will be used? What are the characteristics of the listener population (e.g., native speakers of a particular language, infants 8-10 months)? The general "rule" for a methods section is that it should be sufficiently explicit that the reader could replicate your experiment. That standard is likely too rigorous for an experimental prospectus, but it might help to keep the standard in mind when writing this section.

- **POSSIBLE OUTCOMES AND THEIR IMPLICATIONS**: Given your methodology, what are the possible experimental outcomes? Which of those outcomes would conform to your prediction(s) and would therefore support your (theoretically motivated) hypothesis/hypotheses? Which would be inconsistent with your predictions and hypotheses? What would be the theoretical implications of these different types of findings? As appropriate, you might also want to consider what next step researchers might take in investigating this question.

**Option 2: Critical assessment of the literature addressing a well-defined theoretical issue in speech perception**

Ideally, over the course of the semester, there will be particular topics that especially grab your interest and that, time permitting, you'd like to explore in more detail. This term paper option offers the opportunity for that exploration. The format for this type of paper is not as formulaic as for an experimental prospectus, but some of the same characteristics hold. In particular, you should clearly define the research question to be investigated, situating that research question in relation to one or more theories of speech perception. Early in the paper, you will want to state your main argument. Then you will want to develop your argument through a careful assessment of the relevant literature.

To take one example: one of the theories of speech perception discussed in this course is Motor Theory, first proposed in 1967 and revised in 1985. The more recent discovery of mirror neurons (brain neurons that fire when an animal performs an action, when it observes others performing it, and when it hears the sound caused by the action) has led some researchers to speculate that mirror neurons might support the Motor Theory, while others have argued that this is not the case. An appropriate paper topic would be to present the main positions on both sides of this theoretical debate—and the supporting evidence for each side—and then to argue for your position, providing evidence for why your position is better supported than the alternative.

All papers

Use the term paper as an opportunity to get your creative juices flowing! And **MEET WITH ME** about your topic, preferably by **MARCH 30**. For most topics, I should be able to provide you with background literature that goes beyond what we read for the course. Plus I have a lot of experience helping students take a nascent idea and reformulate it into a doable experiment and/or a cogent argument. (That's one of my favorite things to do, in fact.) There's also the possibility that you could take the experiment that you're conducting for the course a step further and turn it into your term paper, but you'll need to discuss with me how big of a further step is expected.