

LING 412: SPEECH PERCEPTION  
WINTER 2014  
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CTools Course Site: LING 412 001 W14

#### COURSE DESCRIPTION

In typical conversational interactions, humans are highly accurate perceivers of speech. We have little difficulty recognizing the sounds of speech and assigning a meaningful interpretation to sequences of speech sounds. Yet the problems that we encounter in some listening situations, such as difficulties differentiating between sounds in a non-native language (sometimes even after years of experience with that language), hint at the complexity of perceptual processing. The complexity is also apparent when we consider the problems that speech researchers confront when 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, the listener's native language, sociolinguistic factors, and much more. We will consider as well the dominant theories of speech perception and 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 engender new questions. Second, the course will take a hands-on approach to the experimental study of speech perception. Students will participate in classic perception experiments in order to better understand the phenomena as well as the experimental methods. In addition, small groups of class participants will design and execute their own perception experiment. (Advisory prerequisite: Ling 313 or permission of instructor)

#### READINGS

Text: Byrd, D. & Mintz, T. H. 2010. *Discovering Speech, Words, and Mind*. Wiley-Blackwell.

All other readings are posted on the CTools site; most readings are research articles from the primary literature on speech perception.

Some possibly helpful background readings:

- Liberman 1996: an introduction to the original questions in, and approaches to, speech perception by one of the founders of the experimental study of speech perception
- Reetz & Jongman 2009: acoustic analysis (provides more detail than the Byrd & Mintz text)
- Raphael et al. 2006: acoustic cues used in perceiving consonants and vowels
- Raphael et al. 2011: overview of categorical perception
- Beddor 2013: annotated bibliography of major issues and findings in speech perception

## 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 and poster presentation: 30%
- Final paper, including (brief) presentation on last day of class: 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.

## CAPSTONE COMPONENT OF THE COURSE (ALL STUDENTS)

Capstone courses in Linguistics require (i) a final presentation that is commented on by other students and (ii) a capstone poster session (to which departmental faculty and students are invited). In this course, your final presentation will be discussion of your (individual) final paper and your poster will be presentation of the purpose, methods, findings, and conclusions of your group experiment.

## COURSE-RELATED TOOLS

- Course website. The CTools site for the course will be used for posting readings, announcements, handouts, copies of lecture notes (only occasionally!—mostly this is a discussion-based course), discussions, 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.
- Praat. The freeware 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.

## PHONETICS LABORATORY

The department has a state-of-the-art phonetics laboratory. For physiologic measures, the lab has a portable ultrasound system for imaging tongue body movement during continuous speech (and attached to the ultrasound helmet is a camera for recording lip movement and position), pneumotachograph for measuring oral and nasal airflow, and electroglottograph for studying laryngeal function. For acoustic and perceptual studies, the lab has high-quality recording equipment, acoustic analysis packages, Klatt acoustic synthesis and TaDA articulatory synthesis, and software and hardware for running a wide range of perceptual tests. Most data are collected in the sound room in 400 Lorich.

	<b>Date</b>	<b>Topic</b>	<b>Work due</b>	<b>Readings</b>
<b>Introduction</b>	1/14	Course overview & goals	Expt: select experimental group	Recommended: Liberman 1996
<b>What do humans <i>hear</i>?</b> The nature of the acoustic signal	1/21	The acoustic structure of speech		Byrd & Mintz pp. 23-64
	1/28	Acoustic cues and acoustic variation	Acoustic analysis of vowels	Byrd & Mintz pp. 98-125, Peterson & Barney 1952
<b>What do humans <i>perceive</i>?</b> The task of human listeners and investigating that task experimentally	2/4	Perceiving consonants		Byrd & Mintz pp. 127-143, Liberman et al. 1957, McMurray et al. 2002
	2/11	Experimental interlude: introduction to group experiment(s)	Expt: determine design and recording materials	(Readings assigned for each experimental group)
	2/18	Perceiving vowels	Expt: submit design write-up for approval	Ladefoged & Broadbent 1957, Strange et al. 1983, Johnson 1997
<b>Theories of speech perception</b>	2/25	Goals of a theoretical model of speech perception	Expt: record stimuli	Diehl et al. 2004, Liberman & Mattingly 1985, Galantucci et al. 2006
	3/11	Perceiving gestures or perceiving acoustic structure? Two theoretical perspectives on perceptual invariants	Two-page critique	Fowler 1996, Fowler 2006, Lotto & Holt 2006
<b>Speech perception and linguistic experience</b>	3/18	Infant speech perception: becoming a 'native listener'	Expt: complete stimulus editing	Eimas et al. 1971, Werker & Tees 1984, Narayan et al. 2010
	3/25	Experimental interlude: work on class experiment	Expt: conduct test	(None)
	4/1	Perceiving non-native sounds: native-language influences		Best et al. 1988, Best et al. 2001, Albareda-Castellot et al. 2011
	4/8	Perceiving native sounds: sociolinguistic influences	Expt: analysis of results	Niedzielski 1999, Hay et al. 2006
	4/15	Perceiving native sounds: lexical influences Also: Where is speech perception headed? New approaches to long-standing questions	Expt: write-up	Ganong 1980, Myers & Blumstein 2008
<b>Student presentations and poster session</b>	4/22	1. Student presentations of final paper 2. Poster session (dept. faculty and students)		(None)
<b>Final paper</b>	4/29 8am	Final paper due	Final paper due	

## FINAL PAPER OPTIONS

### *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 too rigorous for an experimental prospectus, but it should 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 **APRIL 1**. 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.