

LING 412 / 497: SPEECH PERCEPTION

FALL 2021

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Office Hour: Tuesdays 11:30-12:30 and by appointment

Canvas Course Site: LING 412 001 FA 2021

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 we encounter in some listening situations, such as difficulties differentiating 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 challenges that the field of automatic speech recognition has faced over the years.

This course investigates how listeners interpret the input acoustic stream as a linguistic message. The course begins by considering the acoustic speech signal, and how the structured nature of acoustic variation informs perception. We will then turn to experimental work on speech perception that shows there is not a simple mapping between acoustic property and linguistic percept; rather, listeners process the input signal in ways that depend on their native language, the linguistic context, the social context, and much more. We will also consider the dominant theories of speech perception and theoretical issues that have driven speech perception research for over 60 years, including the foundational question of whether speech perception differs from other types of auditory processing. A theme throughout the course is that students are introduced to the relation between theory and experimentation, and to experimental design, in this interdisciplinary field.

The course goals are:

- (i) To understand the issues and theories that drive the study of speech perception.
- (ii) To understand the relevance of speech perception research to issues of immediate societal importance (e.g., anti-Black racism, speaking and listening while masked) and to understand how we, as linguists, can contribute to important ongoing discussions.
- (iii) To gain first-hand experience in designing and executing a speech perception experiment. We will do this in subgroups that will conduct their own experiment.

READINGS (POSTED ON CANVAS)

- First 3 weeks: excerpts from D. Byrd & T. H. Mintz. 2010. *Discovering Speech, Words, and Mind*. Wiley-Blackwell.
- Other readings: combination of classic and recently published journal articles
- Some possibly helpful and/or interesting background readings:
 - Liberman, A. 1996. *Speech: A Special Code*. Chapter 1 is an engaging introduction to the original questions in, and approaches to, speech perception by one of the founders of the field.
 - Reetz, H. & Jongman, A. 2009. *Phonetics: Transcription, Production, Acoustics, and Perception*. Wiley-Blackwell. Chapters 9 & 10 provide more detail than the text on speech acoustics.
 - Beddor, P. S. 2017. Speech perception (short overview; Oxford Research Encyclopedia of Linguistics).

COURSE REQUIREMENTS

- Active, informed participation in discussions showing you have read and thought about the readings (30%. 5% of this is thoughtful, informed contribution to the theoretical debate on Oct. 28)
- Small-scale acoustic analysis and completion of categorical perception experiment (10%)

- Three two-page critiques: We will be reading many experimental studies on how listeners (human and non-human; adults and infants) perceive speech. Each student will critique three papers spread across the semester. (The Canvas site has a sample critique of the first paper we will read.) (25%)
- Timely, collaborative contributions to the group speech perception experiment, including creating and presenting a poster on the purpose, methods, results, and conclusions of that experiment. (For details, see p. 6 of this syllabus.) (35%)

CAPSTONE COMPONENT OF THE COURSE (ALL STUDENTS)

Capstone courses in Linguistics require a capstone poster session to which departmental faculty and students are invited. In this course, your poster will be a presentation of the group experiment.

COURSE-RELATED TOOLS

- Course website. The Canvas site for the course will be used for posting readings, announcements, handouts, copies of lecture notes (only occasionally!—this is a discussion-based course), discussions, and more. Students should consult the website regularly.
- Praat. The freeware acoustic analysis and stimulus presentation program that we'll be using, Praat, is downloadable from <http://www.fon.hum.uva.nl/praat/>.

PHONETICS LABORATORY

The department has a [state-of-the-art phonetics laboratory](#).

OUR DISCUSSION FORMAT

We want to create an atmosphere of mutual respect in which we recognize that we all bring relevant expertise and experiences to the course and are learning from each other. In our discussions, different viewpoints will arise. We will want to respect others' rights to hold opinions and beliefs that differ from our own, to listen carefully to what they are saying, and to comment in ways that reflect that we have paid attention to the speaker's comments. When we disagree, let's take care to challenge the idea, not the person. In this course, we are also honing our skills as scientists, making it especially important to support our statements with evidence and to provide a rationale for our position.

Although we all have a responsibility to come to class prepared and willing to share, we also have different comfort levels with sharing our ideas. Please be aware of different communication styles, look for ways to expand your communication tool kit, and try to share responsibility for including all voices in the discussion.

OTHER IMPORTANT INFORMATION

- You are expected to adhere to the required safety measures and guidelines of the State of Michigan and U-M. These include wearing a face covering that covers the mouth and nose in class, and not coming to class when ill or in quarantine. Students seeking to request an accommodation related to the face covering requirement under the Americans with Disabilities Act should contact the [Office for Institutional Equity](#).
- I am committed to providing equal opportunity for participation in all aspects of this course. If you think you need an accommodation for a disability, please let me know at your earliest convenience. Also, requests for accommodations may be made by contacting the Services for Students with Disabilities (SSD) Office located at G664 Haven Hall (734-763-3000). The SSD Office typically recommends accommodation through a Verified Individualized Services and Accommodations (VISA) form.
- Students may experience stressors that can impact both their academic experience and their personal well-being. These may include academic pressures and challenges associated with relationships, mental health, alcohol or other drugs, identities, finances, etc. If you are experiencing concerns, seeking help is a courageous thing to do. If the source of your stressors is academic, please contact me so that we can find solutions together. For personal concerns, U-M offers a variety of resources, many which are listed on the [Resources for Student Well-being](#) webpage. You can also search for additional well-being resources [here](#).
- All students are expected to be aware of the College of LSA's standards of academic integrity. If you have any questions, please talk to me. <https://lsa.umich.edu/lsa/academics/academic-integrity.html>
<https://www.lib.umich.edu/academic-integrity>

	Date	Topic	Work due / experiment deadlines	Readings (C) = critique paper
Introduction	8/31	Course overview & goals	Select experimental group	Optional: Liberman 1996, pp. 1-24
What do humans hear? The nature of the acoustic signal	9/2	The acoustic structure of speech	Before class: watch 20-minute video (Canvas>Files>Week 1) on Source-Filter Theory	Byrd & Mintz. pp. 23-64
	9/7	Acoustic cues and acoustic variation	Select critique papers	Byrd & Mintz, pp. 114-125
	9/9	Theories and hypothesis testing; How to read experimental papers		Byrd & Mintz, pp. 98-113 Peterson & Barney 1952
Experimental session 1	9/14	Initial foray into group experiments; basics of experimental design	Due: Acoustic analysis of vowels Experiment: - determine hypotheses and basic experimental design - assign responsibilities	Gr1: Bruderer et al. 2015 Gr2: Corey et al. 2020 Truong et al. 2021
	9/16			
What do humans perceive? The task of human listeners and investigating that task experimentally	9/21	An early, influential perceptual finding: categorical perception (CP)	Take CP experiment <i>before</i> class; we'll share results in class	Byrd & Mintz pp. 127-143 Liberman et al. 1957 (C)
	9/23	Gradient or categorical perception? Listeners are <i>flexible</i> perceivers		Strand 1999 (C)
	9/28	Eye-tracking: listeners are <i>dynamic</i> perceivers		Beddor et al. 2013 (C)
	9/30	Goals of a theoretical model of speech perception		Diehl et al. 2004 (pp. 149-164)
Experimental session 2	10/5	Experimental design	Experiment: - finalize experimental design - identify listeners (if other than class participants) - if possible, record stimuli	Gr 1: Choi et al. 2019 Gr 2: Bottalico et al. 2020
	10/7			
Theories of speech perception: <i>Perceiving gestures or perceiving acoustic structure?</i>	10/12	Motor Theory of Speech Perception	Due: groups submit design write-up for approval	Liberman & Mattingly 1985
	10/14	Direct Realism	Experiment (record and) segment stimuli	Fowler 1996
	10/19	FALL BREAK		
	10/21	Auditory Theory		Lotto & Kluender 1998 (C) Fowler et al. 2000 (C)
	10/26	Exemplar models	Experiment - choose final stimuli to be used in experiment - draft instructions and script	(Review Diehl et al. 2004 as debate preparation)
	10/28	Theoretical debate!		

Experimental session 3	11/2	Finalize your experiment	<i>Experiment:</i> - finalize instructions and script; determine analyses	
	11/4	Conduct your experiment	<i>This is the exciting part!</i>	
Infant speech perception	11/9	On becoming native listeners	Before class: Watch Kuhl TED talk	Werker & Tees 1984 (C) https://www.ted.com/talks/patricia_k_uhl_the_linguistic_genius_of_babies
	11/11		<i>Experiment:</i> Begin to draft background and methods sections of poster.	Bruderer et al. 2015 (C) Choi et al. 2019 (C)
Experimental session 4	11/16	Analyze your results; Elements of an experimental poster	<i>Experiment:</i> - analyze results and run any statistical analyses - work on draft of results and discussion	
	11/18		Due (11/18): draft of background and methods	
Pandemic speech perception	11/23	Producing and perceiving speech in the COVID era		Bottalico et al. 2020 (C) Truong et al. 2021
THANKSGIVING BREAK				
Perceiving ethnicity and race	11/30	Linguistic profiling	Before class: Watch Holliday's talk on linguistic profiling Due: full draft of poster	https://www.youtube.com/watch?v=-SgHxJzI_3U&feature=youtu.be Purnell et al. 1999 (C)
	12/2	Listeners' stereotypes and expectations		McGowan 2015 (C) Jones et al. 2019 (C)
Pulling it all together	12/7	What we've learned (plus I'll try to answer your "here's what I've always wanted to know about speech perception" questions)		
Poster session	12/9	Poster practice and possibly poster session (attended by department faculty and students)		

Group Speech Perception Experiments

Option 1. The relation between perception and production: does constraining articulation affect speech discrimination?

Background

Adult listeners: Our experience with the sound system of our first language(s) influences our perception of the sounds of other languages. In general, adult listeners are accurate discriminators of native-like speech contrasts and relatively poor discriminators of other contrasts (e.g., Best & Tyler 2007).

Infant listeners: Young infants, though, are accurate discriminators even of speech contrasts they haven't been exposed to. For example, English-learning infants accurately discriminate the Hindi dental-retroflex contrast [ɖ]-[d] (Werker & Tees 1984). But when their tongue tips are constrained by a teether, these young infants no longer discriminate this contrast (Bruderer et al. 2015).

Our experiment

What happens when adults' tongue tips/blades are constrained by a teether? Does their discrimination of [ɖ]-[d], like that of infants, decline? A potential challenge in addressing this question is that English-speaking adults' discrimination of this contrast is already relatively poor, so perhaps constraining production would have no effect on discrimination. However, adults' perceptual abilities are often more nuanced than simply poor / accurate discrimination. Thus, assuming better than chance discrimination under unconstrained conditions, this experiment will compare the discrimination accuracy of adults listening to speech with a tongue-constraining teether in their mouths to that of adults with a gummy teether to determine whether the effects observed for infants extend into adulthood.

Option 2. The influence of wearing face masks on speech perception

Background

Wearing a face mask while speaking influences both speech acoustics and speech perception. For example, masks lower the intensity of higher-frequency sounds such as fricatives (e.g., Corey et al. 2020). These and other acoustic effects reduce speech intelligibility (Bottalico et al. 2020) and contribute to poorer word recall (Truong et al. 2021).

There are two possibilities for our experiment:

- (i) *Listening when masked or unmasked:* Wearing a mask as a *listener* doesn't affect speech acoustics, but can it nonetheless affect speech perception? In this version of the experiment, listeners would either be unmasked or masked while listening to masked speech. The main question is whether wearing a mask as a listener increases cognitive demands in ways that result in less accurate perception.
- (ii) Masks cover the mouth, the visually most important source of articulatory information. But can listeners use other visual information (e.g., jaw movements) when differentiating speech sounds? In this version of the experiment, listeners would hear either masked audiovisual speech or masked audio-only speech to determine whether even seemingly minor visual cues contribute to more accurate perception.

Both experiments [Note: all papers referenced above are on the Canvas site]

The syllabus has a detailed schedule for completing the various parts of these experiments. As the culmination of your experiment, each group will make a poster that will be presented to Linguistics faculty and students in an end-of-semester poster session. Posters typically consist of BACKGROUND (a brief summary of the relevant literature), RESEARCH QUESTIONS and HYPOTHESES (why you're conducting this experiment and what you expect to find), METHODS (description of the stimuli, procedures, and participants), RESULTS, and DISCUSSION / CONCLUSION.

All students are expected to participate in all aspects of the experiment, although I encourage one or two students from each group to take primary responsibility for specific components. All students are expected to contribute equally to their group's experiment and the poster. Within each group, each student will assign themselves and each other member of the group a rating from 1 to 5 (5 being high) for the level of their contribution. (If everyone contributes more or less equally, each student could—and in past course offerings, often does—receive a 5.)