Syllabus for *Neurolinguistics*
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Course Description

This course introduces the neural machinery behind our ability to speak and understand language. In three sessions we discuss: (i) neurolinguistic questions and methods, (ii) the brain bases of speech perception and phonology, and (iii) syntax and semantics. Special attention is given to how theories of linguistic computations and representations can inform, and be informed by, our understanding of the brain.

Schedule

Day 1: Neurolinguistic questions and methods

The first day of the course introduces the *tools* used to study the cognitive neuroscience of language along with the kinds of *linguistic questions* that can be answered with these tools.

Two broad themes are (i) distinguishing questions about neural implementation from questions about processing algorithms and linguistic representations (Chomsky, 1965; Marr, 1982), and (ii) articulating *linking hypotheses* between representations and neural implementations (Embick and Poeppel, 2015; Marantz, 2005).

We then discuss relevant aspects of the brain's structure and organization as well as the underlying principles of the major methodologies used in Cognitive Neuroscience to measure brain anatomy and function, including:

- Aphasias and the deficit/lesion method
- Magnetic Resonance Imaging (MRI and fMRI)
- Electroencephalogaphy and Event-Related Potentials (EEG and ERP)
- Electrocotigography (ECoG)
- Magnetoencephalography (MEG)

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Readings

- Marr (1982) Introduction and Chapter 1
- Selections from Kemmerer (2014)

Day 2: The brain bases of speech perception and phonology

The second day of the course introduces the basic principles of how sound is transduced into a neural code suitable for speech perception, and discusses some theoretical implications from research on the neural bases of phonology.

We first discuss the use of *spatial coding* to neurally represent acoustic information in the auditory periphery and in the primary auditory cortex (e.g. Barton et al., 2012) and the important distinction between *spectral* and *temporal* information for speech perception.

We then turn to theories for how *continuous* acoustic input is converted into *discrete* linguistic representations along two separate processing streams (Hickok and Poeppel, 2007). Drawing on the framework of Poeppel et al. (2008), we further discuss evidence for two distinct *temporal windows of integration* tuned to detect phonetic features and syllabic properties, respectively, and the neural mechanism of a *cortical oscillator* (Giraud and Poeppel, 2012). This discussion draws on both behavioral and neural evidence (Saberi and Perrott, 1999; Saoud et al., 2012; e.g. Morillon et al., 2012).

Lastly, we explore studies that examine evidence for a neural code specific to phonemic, not just acoustic, features (Mesgarani et al., 2014; Scharinger et al., 2011).

Readings

- Poeppel et al. (2008)
- Scharinger et al. (2011)

Day 3: The brain bases of syntax and semantics

The final day of the course turns to the neural bases of syntactic and semantic composition.

We first attend to the fundamental role of *prediction* in sentence comprehension, which offers a window into understanding event-related potential (ERP) components associated with language, such as the N400 and P600 (Kutas et al., 2014).

We then address the brain bases of *structure-building* operations from carefully constructed experimental designs (Bemis and Pylkkänen, 2011), patient data (Dronkers et al., 2004), and naturalistic data (Brennan et al., 2016). We examine evidence that probes the distinction between syntactic and semantic composition (Wilson et al., 2014; Zhang and Pylkkänen, 2015), and special attention is paid to

the application of computational models to studying the brain bases of sentence processing (Brennan, 2016).

Finally, the discussion may **optionally** turn either to (i) the brain bases of *dependency-processing*, including the question of domain-specific versus domain-general neural systems for language (Amici et al., 2007; Matchin et al., 2014), or to (ii) the neural bases of *conceptual representations*, drawing on data from multilingual speakers and patients with neurodegenerative disorders (Correia et al., 2013; Patterson et al., 2007).

Readings

- Kutas et al. (2014)
- Brennan (2016)

References

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