Phenomenology and first person approaches

It can be argued that the hallmark of mental life is experience. The philosophical school that took this claim as its foundation and is attempting to develope an entire scientific mehtodology based upon it is phenomenology (notably: Brentano, Husserl, Heiddeger, Merlleau-Ponty). Essentially, experience can be studied only from within, employing what is now called "First person methodologies". Recently, these have been gaining force in the cognitive-psychological study of consciousness. This lecture will present basic concepts and ideas of the methods at hand, drawing upon both psychology and philosophy, and focusing on consciousness research.
Most experiments in cognitive psychology involve some presentation of stimuli on a CRT computer screen monitoring subjects’ responses. I will talk about the complexity involved in these types of experiments when linguistic processing is investigated. Specifically I will examine the logic of priming, masked priming, rapid visual serial presentation, and parafoveal preview presentation.

Imaging using fMRI is based on ‘viewing neural activity by proxy’ – measuring changes in blood flow and oxygenation as reflections of neural activity. It is thus critical to understand how neural activity is transformed to hemodynamic changes. We will discuss mechanisms of neurovascular coupling; how they determine the spatial and temporal resolution of fMRI; what type of neural activity is reflected in fMRI (input, output); and how these affect the study of special populations.

fMRI studies rely heavily on statistics to extract reliable effects. Most analyses schemes are based on mass univariate analyses using the general linear model scheme. Determining statistical significance becomes a major issue. We will discuss typical designs of fMRI experiment, the common analyses schemes, and common pitfalls.

Tutorial on methods for conducting and analyzing simple psychophysical experiments - adaptive procedures and signal detection

The primary sensory cortices are characterized by a topographical mapping of basic sensory features. Multiple retinotopic maps were found in the visual cortex, organized in mirror symmetry topography. These maps were fundamental to understanding the organization of visual cortex, and were used as the basis for delineating different visual areas in humans and primates, in which each functionally separate visual area contained a map of the sensory epithelia. The detection of these maps was enabled by using a special experimental design and analysis approach. We will discuss the experimental design, and how it could be applicable to map many types of features - frequency maps in auditory cortex, eccentricity maps in visual cortex and others parts of the brain (tonotopy /

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cochleotopy / mototopy, somatotopy). The different ways spectral analysis can be carried will also be covered, among which are Fourier analysis and linear correlation with lags. Finally we will discuss the extension of this approach to multi frequency designs, and the detection of interaction effects, specifically its application in multisensory integration research.

An increase in fMRI signal within a particular brain area (e.g. primary visual cortex) is generated by the activity of a very large number of neurons. When we measure fMRI responses in the same area in different experiments, are the same exact neurons responding in all cases? or are different sub-populations of neurons generating what seem like identical fMRI responses? Answering this question is imperative for understanding the selectivity (functional role) of neurons in particular brain areas. Multivariate pattern analysis is an advanced fMRI analysis technique that can sometimes help us answer these questions.

Electrophysiology provides a powerful tool for monitoring brain activity at an unsurpassable resolution. We will review mostly non-invasive methods used in humans, including EEG and MEG with aim of understanding what can and cannot be expected from these methods. We will cover their underlying physiology; measurement and analysis of event-related potentials; artifacts; analysis of “oscillations” and spectral perturbations; analysis of connectivity; challenges of inferential statistics – the multiple comparison problem and possible solutions; common caveats and pitfalls.

We will discuss the inverse problem of source localization using EEG and MEG and possible approximations.