Institute of language, communication and the brain

ILCB

Summer school

2nd Edition

2-6 September 2019
Marseille

The ILCB brings together experts in linguistics, neuroscience, psychology, medicine and computer science to understand and to model the way that language functions. The objective of the Institute is to create a generic model of language processing and its cerebral bases.

The 2nd ILCB Summer School offers introductory and advanced classes in four core fields of Cognitive Science, reflecting the expertise of the Institute: Applied mathematics, statistics and networks; Neuroscience and behavior; Language and cognition; Computer science and machine learning. Keynotes and social events complete this week of immersion, in the beautiful creek of Malmousque.

KEYNOTE SPEAKER
Marc CAVAZZA (University of Greenwich)

REGISTRATION: https://forms.gle/xdc3ECxy6cxTfgvP7

Due to the limited number of places, you first have to apply for attending the school. Confirmation of attendance will be sent one month before the beginning of the school.

Venue: Station maritime d'Endoume, Chemin de la Batterie des Lions, 13007 Marseille

Website: https://www.ilcb.fr/education/summer-school/

Contact: contact@ilcb.fr

Organizing Committee
Christian Bénar, Magalie Ochs, Adrien Meguerditchian, Philippe Blache,
Nadéra Bureau, Julie Abbou

*NeuroSchool (nEURo*AMU), the neuroscience graduate school of Aix-Marseille Université, is pleased to support excellence initiatives such as the Summer School of the Institute for Language, Communication and the Brain.*

NeuroSchool
(Aix∗Marseille Université

BASIC COURSES
Program

Monday

10:00 -11:30	Brain for dummies	*B. Morillon*
11:30-13:00	Basis of Brain imaging techniques	*C.G. Bénar*
14:30-17:30	Language and the Brain	*K. Strijkers*

Tuesday, Wednesday, Thursday, Friday

9:30-11:00	Language and Cognition	*P. Blache and J. German*
11:30-13:00	Behaviour: from Aristotle to Cognitive Sciences	*A. Meguerditchian and M. Montant*
14:30-16:00	An Introduction to Machine Learning	*S. Takerkart and H. Kadri*
16:30-18:00	Applied Statistics	*P. Pudlo and B. Giusiano*

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
09:30	*Welcome*	Language and Cognition	Language and Cognition	Language and Cognition	Language and Cognition
10:00	Brain for Dummies				
10:30					
11:00		Coffee Break			
11:30	Basis of Brain imaging techniques	Behaviour: from Aristotle to Cognitive Sciences	Behaviour: from Aristotle to Cognitive Sciences	Behaviour: from Aristotle to Cognitive Sciences	Behaviour: from Aristotle to Cognitive Sciences
12:00					
12:30					
13:00	Lunch				
13:30					
14:00					
14:30	Language and the Brain	An introduction to Machine Learning	An introduction to Machine Learning	An introduction to Machine Learning	An introduction to Machine Learning
15:00					
15;30					
16:00		Coffee Break			
16:30		Applied Statistics	Applied Statistics	Applied Statistics	Applied Statistics
17:00					
17:30					
18:00	Social Event				
18:30				Keynote: Marc CAVAZZA	
19:00					

BASIC COURSES
Abstracts

Brain for Dummies
B. Morillon (INS)

In this introduction course, we will go through a broad overview of what a human brain is, by briefly describing its key structural and functional aspects.

Basis of brain imaging techniques
C.G. Bénar (INS)

This lecture will present the basis of the brain imaging techniques (EEG, MEG, fMRI, intracerebral EEG): where do the signals originate, and what are their temporal and spatial characteristics. I will also introduce the signal processing methods that permit to use them in order to localize brain activity, and define the interactions between brain regions. I will present the potential pitfalls of signal analysis, and the new opportunities given by modelling and simultaneous recordings.

Language and the Brain
K. Strijkers (LPL)

The objective of a brain language model is to integrate linguistic elements and psycholinguistic mechanisms with its underlying neural structure. That is, how does our brain retrieve and process linguistic representations in time and space to produce language behaviour? Addressing this question is far from easy and different approaches, both in terms of theoretical framework as methods, can result in different answers. In this course I will present some of the most influential brain language models and classical debates in this field, as well as the brain data that has fuelled these models and debates. The goal is to obtain basic understanding of how neurolinguistic research attempts to tackle the difficult question of how our brain can achieve the marvellous feat that is language.

Language and Cognition
P. Blache (LPL) and J. German (LPL)

This course introduces foundational concepts and theoretical frameworks from the field of linguistics, which addresses how language is structured, and in what sense the source of this structure lies in the mind of an individual language user. The course will be organized primarily according to the traditional subfields of linguistics, including phonetics, phonology, morphology, syntax, and semantics. Subsequently, it will explore a selection of modern theoretical frameworks which have the potential to bridge the gap between linguistic and neurocognitive perspectives on language. Regular discussions will address how linguistic structure ultimately links up with cognitive processes, as well as with the behavioral and neural measures that we use to study those processes.

Behaviour : from Aristotle to Cognitive Sciences
A. Meguerditchian (LPC) and M. Montant (LPC)

This course will explore the history of the study of behaviours in humans and other animal species across diverses - and sometimes divergent - approaches including behaviorism, objectivist ethology, behavioral biology, sociobiology... We will develop the specific contribution of the emergence of cognitive science and neuroscience which clearly addressed the question of the mind in the understanding of the behavior. These aspects will be illustrated through the significant advances in comparative psychology researches which infer and investigate the cognitive process in human and nonhuman animals

An introduction to machine learning
S. Takerkart (INT) and H.Kadri (LIS)

This course aims to provide an overview of problem solving and data modeling from a machine learning perspective. The concepts of data representation, distribution, statistics as well as training, validation and testing will be reviewed, as well as the details of some learning algorithms. Practical work will be performed on a concrete problem with standard tools, which will allow to see the basic concepts of programming in Python.

Applied statistics
P. Pudlo (I2M) and B. Giusiano (INS)

The first part of this course will present the basic principles of inference within the classical paradigm of statistics. With illuminating examples, we will recall some essential notions such as: estimation, mean comparison, variance analysis and linear regression. It will serve as well as a practical introduction to the R language. The second part will introduce the Bayesian paradigm, i.e., how to handle the uncertainty on the parameters of interest. We will show on case studies how one can compute the remaining uncertainty when analyzing the data, and how does the probabilistic framework allows to rely on other information to correct the information of the data (historical data, expert opinions,...), and allows to model precisely the problem under examination. The course will end with a debate on important issues such as the reproduction crisis, subjective vs objective methods in Bayesian statistics.

ADVANCED COURSES
Program

Monday to Friday

9:30-11:00   Early development of communication – Tutorial *M. Jover*
                                                            C. François
11h30-13:00 Chomskynner: From universal grammar to implicit statistical learning and
             usage-based approaches, a paradigm shift?   *A. Rey*
14:30-16:00 Neural oscillations: nature, functions and analyses tools
                                                          B. Morillon (INS)
                                                          A. Brovelli (INT)
                                                          C. Bernard (INS)
16:30-18:00 Engineering Techniques   *CREx*

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
09:30	Early development of communication	Early development of communication	Early development of communication	Early development of communication	Early development of communication
10:00					
10:30					
11:00	Coffee Break				
11:30	From universal grammar to implicit statistical learning and usage-based approaches	From universal grammar to implicit statistical learning and usage-based approaches	From universal grammar to implicit statistical learning and usage-based approaches	From universal grammar to implicit statistical learning and usage-based approaches	From universal grammar to implicit statistical learning and usage-based approaches
12:00					
12:30					
13:00	Lunch				
13:30					
14:00					
14:30	Neural oscillations: nature, functions and analyses tools	Neural oscillations: nature, functions and analyses tools	Neural oscillations: nature, functions and analyses tools	Neural oscillations: nature, functions and analyses tools	Neural oscillations: nature, functions and analyses tools
15:00					
15;30					
16:00	Coffee Break				
16:30	Engineering Techniques	Engineering Techniques	Engineering Techniques	Engineering Techniques	Engineering Techniques
17:00					
17:30					
18:00					
18:30	Social Event			Keynote: Marc CAVAZZA	
19:00					

ADVANCED COURSES
Abstracts

Early development of communication – Tutorial,
Marianne Jover (Psyclé), Clément François (LPL)

From a developmental point of view, it is unlikely that language and intentional communication appear together around the age of one year. Selectionist and interactionist approaches suggest that transaction between the infant and the environment based the communicative development before birth. The tutorial contains a theoretical introduction on early development and learning of communication. The second and third sessions will focus on the early development of communicative gesture and adults' understanding of the infants' movements (Jover & Scola, 2018). Finally, the two last sessions will focus on (i) the neural changes supporting the development of early speech perception abilities and, (ii) on the learning mechanisms allowing infants to acquire and learn new words.
This tutorial is linked to our current researches and will comprises both theoretical presentation and data presentation and analysis.

Chomskynner: From universal grammar to implicit statistical learning and usage-based approaches, a paradigm shift?
Arnaud Rey (LPC)

In 1957, the publication of Syntactic structures by N. Chomsky and Verbal Behavior by B. F. Skinner introduced two radically different approaches to the study of language. Several psychology textbooks report that Chomsky's famous article, published two years later and criticizing Skinner's approach, is both the starting point of the cognitive era and a breaking point with behaviorism. After a brief and critical presentation of these approaches, I will pave the way for a recent article published in Psychological Review this year by McCauley and Christiansen (2019) showing how current approaches based on language use and implicit statistical learning have slowly created a favorable climate for a paradigm shift in the study of language processes.

Advanced course: Neural oscillations: nature, functions and analysis tools,
Benjamin Morillon (INS), Andrea Brovelli (INT), Christophe Bernard (INS)

The interdisciplinary approach supported at the ILCB to better understand the neural bases of language and communication crucially depends on neural recordings of participants performing specified cognitive tasks (of perception and/or production). Language and communication being in essence temporal, the vast majority of the experiments performed in the laboratories affiliated to the ILCB capitalize on time-resolved neuroimaging methods, which allows capturing the dynamics of neural activity. This principally includes electroencephalography (EEG), but also intracranial EEG and magnetoencephalography (MEG). The signal captured by these methods corresponds to the global oscillatory activity of populations of neurons. The amplitude of this signal is closely linked to the degree of synchrony between the activity of neurons present in a given region.

To better investigate the neural bases of language and communication, it is thus mandatory to properly understand the nature of the signal measured by these neuroimaging methods. This advanced course will combine theoretical and practical approaches to better understand neural oscillations. This course will be composed of three main parts in which we will: 1. Define the nature and the properties of neural oscillations; 2. Describe the main cognitive theories involving neural oscillations, notably in relation to speech, language, and communication (but not only); and 3. Introduce the latest approaches allowing us to estimate the network dynamics underlying these oscillatory signals, which notably rely on information theory.

Prerequisite: basics notions in probability theory and statistics (conditional probabilities and entropy)

Engineering Techniques
CREx

- From raw signal to ERPs and oscillations: Processing of EEG, step-by-step. The principal processing steps involved in going from the raw electroencephalography (EEG) signal to the calculation of event-related potentials (ERP) and oscillatory activity. Each step will be explored with a view to answering the following questions, "how are we changing the signal?", "why are we changing it in this way?", "is this step always necessary?" and "what pre-cautions should we take in carrying out this processing step?".

- Blind Source Separation in artifact correction and event-related potential (ERP) analysis: Introduction of one class of blind source separation (BSS) methods, Independent Component Analysis (ICA),which is a linear decomposition technique that is often applied both in the correction of artefacts in neurophysiological signals (e.g. EEG, MEG) as well as in the analysis of event-related and oscillatory activity. The theory behind ICA will be introduced and we will demonstrate it's application in the correction of artefacts typically found in neurophysiological time-series.

- Processing of fMRI data, step-by-step, using SPM12 software: principal processing steps involved of classical functional Magnetic Resonance Imaging (fMRI) Analyses. Using the open-source software SPM (version 12), we will go from the raw anatomical and functional raw images to statistical parametric mapping (SPM) analysis of whole brain. This session is intended for a beginner audience.

- Processing of MEG data, step-by-step, using Brainstorm software: steps involved of magnetoencephalography (MEG) data analyses will be studied. Using the open-source software Brainstorm, we will go from the raw anatomical and functional raw images to event-related related fields and time-frequency analyses. This session is intended for a beginner audience.

- Physics and acoustic aspects of the speech production: Speaking is a complex activity that implies numerous high level and low level controls. While speech permits to communicate, producing various identified class of sounds, voice convey information about certain characteristics of the locutor itself and about its inner state.
We will first look at the vocal tract, identifying the main actuators/contributors (as well as their physic, mechanic and acoustic properties) that lead to the production of various sounds which, when combined, permit the speech production.
We will talk about vowels and consonants specificities, presenting rapidly the main classical signal processing to study and characterize them.
Online demos will permit to better understand acoustic properties of sounds produced, as well as the signal processing used to study these sounds.

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