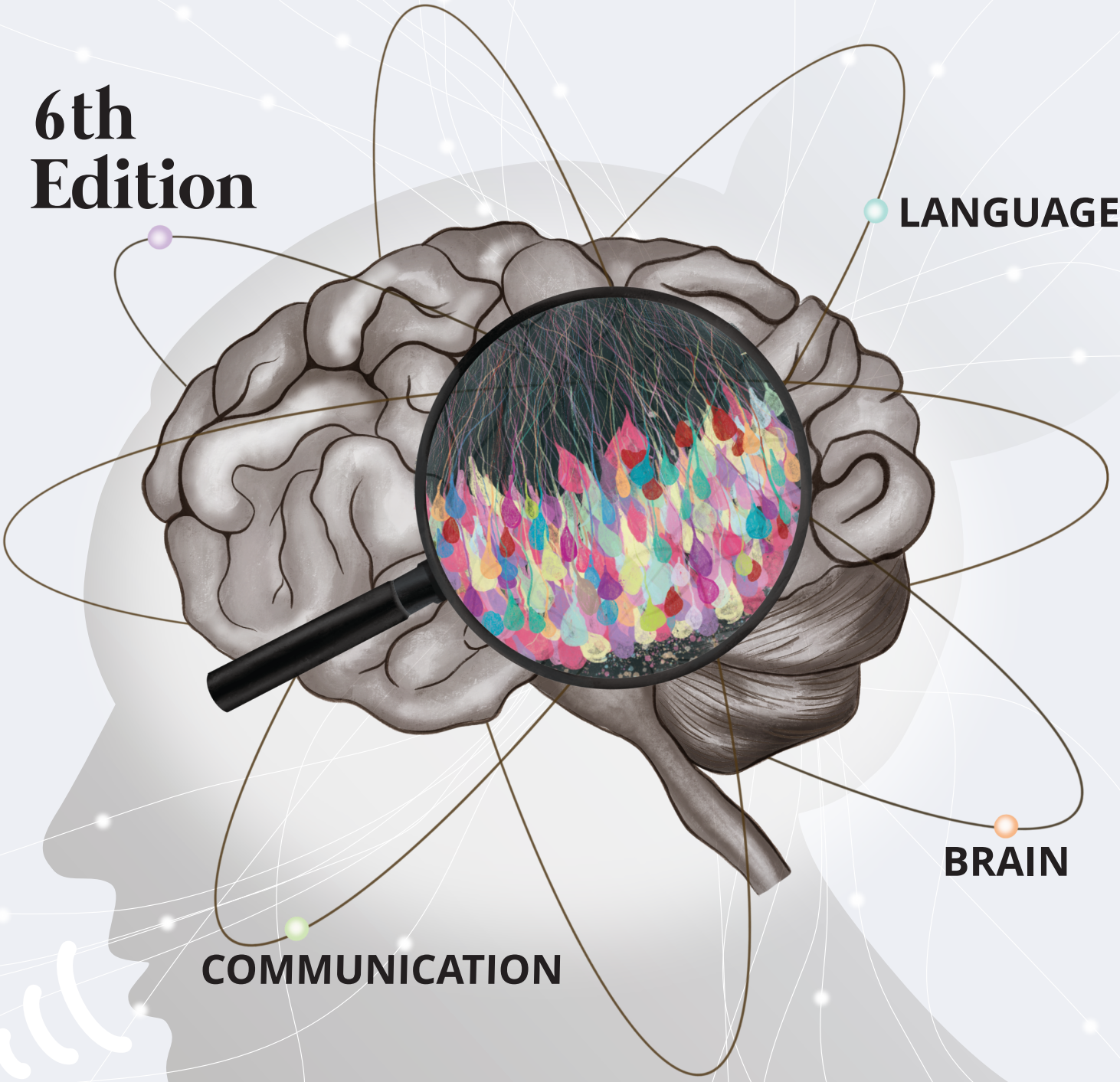
ILCB SUMMER SCHOOL

August 28th to September 1st, 2023

Centre International de Rencontres Mathématiques - 163 avenue de Luminy - **Marseille** - France

6th Edition



ILCB Institute of Language, Communication and the Brain

Summer school

FRANCE 2030 | Aix*Marseille université Socialement engagée | A*Midex Initiative d'excellence Aix-Marseille | cnrs | CIRM

The ILCB summer school will be held from Monday August 28th to Friday September 1st, 2023, at the Centre International de Rencontres Mathématiques in Luminy (CIRM). This interdisciplinary summer school brings knowledge on language and communication to international and local participants coming from very different backgrounds (linguistics, neurosciences, psychology, computer science, mathematics). The courses are given by ILCB researchers or by external colleagues of international renown.

For this 6th edition, participants will be able to choose between introductory and advanced courses. The morning introductory courses will be reserved for mathematics and computer science courses. Those in the afternoon will be reserved for general introductory courses (conceptual and methodological) on ILCB disciplinary fields: linguistics, psycholinguistics, neurolinguistics, and AI.

The advanced morning classes will develop a multidisciplinary theme over several days and will be based on the latest research (e.g., language and pathology, biology of language, from sound to cognition, mixed models).

In the afternoon, participants will be able to attend more focused "state-of-the-art" sessions addressing ILCB key themes.

Several social events (welcome party, social dinner, walks in the callanques) will allow participants to get to know each other in a friendly atmosphere.

On Friday morning, Philippe Blache and Patrick Lemaire will present two cross-cutting topics on "how do we understand and access meaning? and "cognition and emotion" respectively.

Finally, a plenary keynote constitutes a high point of the summer school. It will be given this year by Fenna Poletiek, the IMéRA/ILCB 2023/2024 chair.

Trombinoscope

Introductory classes

Jean-Marc Freyermuth
I2M, AMU & CNRS

Thomas Schatz
LIS, AMU & CNRS

Adrien Meguerditchian
LPC, AMU & CNRS

Benjamin Morillon
INS, AMU & Inserm

Víctor José López Madrona
INS, ILCB AMU & Inserm

James German
LPL, AMU & CNRS

Frédéric Béchet
LIS, AMU & CNRS

Advanced classes

François-Xavier Alario
LPC, AMU & CNRS

Véronique Sabadell
INS, AMU & Inserm

Serge Pinto
LPL, AMU & CNRS

Agnès Trébuchon
AP-HM, INS, AMU & Inserm

Johannes Ziegler
ILCB, LPC, AMU & CNRS

Marie Montant
LPC, AMU & CNRS

Pascal Belin
INT, AMU & CNRS

Benjamin Morillon
INS, AMU & Inserm

Etienne Thoret
PRISM & AMU

Royce Anders
EMC, Lyon 2 Univ.

Sophie Achard
GIN, Grenoble Univ.

Chotiga Pattamadilok
LPL, AMU & CNRS

Trombinoscope

Advanced classes

Christian-Georges **Bénar**
INS, AMU & Inserm

Mariapaola **D'Imperio**
LPL, AMU & CNRS

Abdellah **Fourtassi**
LIS, AMU & CNRS

Clément **François**
LPL, AMU & CNRS

Marianne **Jover**
PsyCle & AMU

Isabelle **Dautriche**
LPC, AMU & CNRS

Ricard **Marxer**
LIS, AMU & CNRS

Benoit **Favre**
LIS, AMU & CNRS

Daniele **Schön**
INS, AMU & Inserm

Yannick **Esteve**
LIA, Avignon Univ.

Kristof **Strijkers**
LPL, AMU & CNRS

Jean-Rémi **King**
ENS-PSL & CNRS

Cheryl **Frenck-Mestre**
LPL, AMU & CNRS

Trombinoscope

CREx (ILCB center of experimental resources)

Thierry **Legou**
CREx, ILCB, AMU & CNRS

Valérie **Chanoine**
CREx, ILCB, AMU & CNRS

Christelle **Zielinski**
CREx, ILCB, AMU & CNRS

Deirdre **Bolger**
CREx, ILCB, AMU & CNRS

Franziska **Geringswald**
CREx, ILCB, AMU & CNRS

Cross-cutting topics

Patrick **Lemaire**
LPC, AMU & CNRS

Philippe **Blache**
ILCB, LPL, AMU & CNRS

Keynote

Robert **French**
Emeritus Research Director at the CNRS
Laboratory for Research on Learning and Development, University of Bourgogne

Fenna **Poletiek**
Chaire IméRA-ILCB
Institute of Psychology, Leiden University, Netherlands

Planning : introductory classes

	Monday 28	Tuesday 29	Wednesday 30	Thursday 31	Friday 1st
9h - 10h15	Room S2 **R programming and statistics** J-M. Freyermuth				A1/A2 **Emotion and cognition** P. Lemaire
10h15 - 10h45	**BREAK**	**BREAK / CREx**	**BREAK**		**BREAK**
10h45 - 12h	Room S2 **Python programming and machine learning** T. Schatz				**How do we understand each other ?** A1/A2 P. Blache
12h - 14h30	**LUNCH**				**LUNCH**
14h30 - 15h45	S2 **Linguistics** J. German	S2 **Brain for dummies** B. Morillon	**Animal Behaviour** S2 A. Meguerditchian	S2 **Artificial intelligence** F. Béchet	**Trip in the calanques**
15h45 - 16h15	**BREAK**	**BREAK / CREx**	**BREAK**		
16h15 - 17h30	S2 **Linguistics** J. German	S2 **Imaging for dummies** V. López Madrona	**Animal Behaviour** S2 A. Meguerditchian	S2 **Artificial intelligence** F. Béchet	
17h30 - 18h30	**BREAK**				
18h30 - 19h30	**Social events**		**Keynote** Robert French	A1/A2 **Keynote** Fenna Poletiek	
19H30	**DINNER**				

Planning : advanced classes

	Monday 28	Tuesday 29	Wednesday 30	Thursday 31	Friday 1st
9h - 10h15	**Language & pathology** F-X. Alario — A1: **Language & biology** M. Montant; A2: M. Montant	**Language & pathology** S. Pinto — A1: **Language & biology** M. Montant; A2: M. Montant	**Language & pathology** A. Trébuchon — A1: **Language & biology** M. Montant; A2: M. Montant	**Language & pathology** J. Ziegler — A1: **Language & biology** M. Montant; A2: M. Montant	A1/A2 **Emotion and cognition** P. Lemaire
10h15 - 10h45	**BREAK**	**BREAK / CREx**	**BREAK**		**BREAK**
10h45 - 12h	**From sound to cognition** E. Thoret — A1: **Mixed models** R. Anders; A2: R. Anders	**From sound to cognition** B. Morillon — A1: **Mixed models** R. Anders; A2: R. Anders	**From sound to cognition** B. Morillon — A1: **Mixed models** R. Anders; A2: R. Anders	**From sound to cognition** P. Belin — A1: **Mixed models** R. Anders; A2: R. Anders	**How do we understand each other ?** A1/A2 P. Blache
12h - 14h30	**LUNCH**				**LUNCH**
14h30 - 15h45	**Graph theory & brain imaging** S. Achard — A1: **Cognitive & neural mechanisms of reading acquisition** C. Pattamadilok; A2: C. Pattamadilok	**Prosody** M. D'Imperio — A1: **Language & Acquisition** A. Fourtassi and al.; A2: A. Fourtassi and al.	**Multimodal language understanding, latest developments** B. Favre — A1: **Predictive coding** D. Schön; A2: D. Schön	**Language in the brain and algorithms** J-R. King — A1: **Bilingualism** C. Frenck-Mestre; A2: C. Frenck-Mestre	**Trip in the calanques**
15h45 - 16h15	**BREAK**	**BREAK / CREx**	**BREAK**		
16h15 - 17h30	**Graph theory & brain imaging** S. Achard — A1: **Source localization in MEG and EEG** C-G. Bénar; A2: C-G. Bénar	**Prosody** M. D'Imperio — A1: **Language & Acquisition** A. Fourtassi and al.; A2: A. Fourtassi and al.	**Speech processing in the deep learning area** Y. Esteve — A1: **Cognitive & neural dynamics of basic conversation** K. Strijkers; A2: K. Strijkers	**Language in the brain and algorithms** J-R. King — A1: **Bilingualism** C. Frenck-Mestre; A2: C. Frenck-Mestre	
17h30 - 18h30	**BREAK**				
18h30 - 19h30	**Social events**		**Keynote** Robert French — A1/A2	**Keynote** Fenna Poletiek — A1/A2	
19H30	**DINNER**				

Introductory classes

Jean-Marc Freyermuth
I2M, AMU & CNRS

R programming and Statistics

This course introduces the basics of descriptive statistics, in particular, the concepts of population, variable, observation, as well as the representation of numerical data as tables and graphics, the measures of centrality and dispersion, and finally Exploratory Data Analysis. From real data examples, we will produce high quality graphics using the R software and the ggplot2 package. The last lecture focuses on the more advanced topic of describing the dynamics of functional connectivity from EEG traces.

Python programming and machine learning

This class introduces the central concepts and methods of modern machine learning through practical examples using elementary mathematics and the python programming language. No prior knowledge of machine learning and computer programming is assumed. Required mathematical concepts should be familiar from middle-school and/or will be explained in class, with a focus on the development of an intuitive understanding.

Thomas Schatz
LIS, AMU & CNRS

Adrien Meguerditchian
LPC, AMU & CNRS

Animal Behaviour: From Aristotle to Cognitive Sciences

This course will explore the history of the study of behaviours mostly from the animal research field. We will travel across diverses – and sometimes divergent – approaches including behaviorism, objectifist ethology, behavioral biology, sociobiology... We will finish by the specific contribution of the emergence of cognitive science in the field which clearly addressed the question of the mind in the understanding of the behavior.

Brain for dummies

This course will provide a general overview of the human brain, mainly through a historical, theoretical, and structural viewpoint.

Benjamin Morillon
INS, AMU & Inserm

Introductory classes

Víctor José López Madrona
INS, ILCB AMU & Inserm

Imaging for dummies

In this course, we will see the basis of functional brain imaging from three different perspectives: functional magnetic resonance imaging (fMRI), electro and magnetoencephalography (EEG/MEG), and intracerebral EEG. Each modality provides a specific and unique way to measure the activity of our brain and all of them are complementary. We will briefly review their mechanisms and recording systems and provide an overview of the possible analysis that can be done. After the course, you will have the competences to decide the best modality to answer our scientific questions.

Linguistic theory for the cognitive sciences

This course presents an overview of the essential components of and empirical motivations for the major branches of modern linguistic theory, with a special emphasis on phonetics, phonology, syntax, and semantics. The primary aim is to situate linguistic theory, and the cognitive representations of linguistic structure it proposes, within the cognitive sciences more generally, as well as to provide researchers in the cognitive sciences with fundamental analytical skills for addressing issues in language production, perception, and processing from a variety of methodological perspectives, including psychological, neurological, and computational ones.

James German
LPL, AMU & CNRS

Frédéric Béchet
LIS, AMU & CNRS

Artificial intelligence

Through the lens of Natural Language Processing, this class will introduce the main concepts and methods of Artificial Intelligence, placing them in a historical perspective from the converging viewpoints of computer science, linguistics and signal processing

Advanced classes

François-Xavier Alario
LPC, AMU & CNRS

Véronique Sabadell
INS, AMU & Inserm

Language and pathology

Connecting healthy and pathological language processing, *F.-Xavier Alario & Véronique Sabadell*

How different are healthy and pathological language processing? Can the study of patients inform our understanding of the general population? Can theories describing "canonical" unimpaired language processing reliably inform clinical decisions? At what level of description should the pathological aspect of processing be described? How should remediations be conceived and implemented for these impairments? This segment of the "Language & Pathology" course will present some broad concepts and invite an interactive discussion of the links between healthy and pathological language processing. It will take examples from the three following sessions thus providing a general introduction to the course. You will be expected to speak out, not only listen and write.

Prerequisite: A general interest for language impairments or the links between brain and cognition.

Serge Pinto
LPL, AMU & CNRS

Studying speech motor control from its impairment: a general introduction to dysarthrias : *Serge Pinto*

Motor Speech Disorders refer to a set of signs affecting the control and production of speech consequent to neurological impairment. They are characterized by an approach which dichotomizes motor speech disorders in two modalities: apraxia of speech and dysarthria, which can be distinguished on at least two fundamental points: (1) dysarthria is the consequence of motor dysfunctions also involving the limbs (rigidity, akinesia, ataxia, dystonia, etc.) and of which a specific pathophysiology is determined; dysarthric disorders are constant, predictable, whereas this is not the case for patients suffering from apraxia of speech; (2) verbal dysfluency, marked in apraxic patients, is not characteristic of dysarthric speech. After presenting the classification and pathophysiology of dysarthrias associated with specific movement disorders, I will briefly introduce the relevance of targeting research on dysarthria, and mainly hypokinetic dysarthria in Parkinson's disease, as a model for a better understanding of the involvement of cortico-basal ganglia-cortical pathways in speech motor control.

Basic notions of motor functional neurophysiology would be helpful, but it is not a pre-requisite for this introductory course.

Agnès Trébuchon
AP-HM, INS, AMU & Inserm

Language pathology and Epilepsy : *Agnès Trèbuchon & Véronique Sabadell*

In case of drug-résistant epilepsy the surgery procedure consisting in the resection of the "seizure generator" is considered as the treatment of choice. However, this procedure may induce Language deficits, particularly after left temporal surgery. In this context, counseling at the individual level patients about the risks and benefits of surgery can be challenging. The functional exploration of the language network is by consequent crucial.

Through the language deficit during seizure, the language deficit during direct electrical stimulation (SEEG or awake surgery) we will discuss the clinical link between language network and epilepsy and the question of the functional reorganization.

Learning to read and dyslexia: from theory to intervention: *Johannes Ziegler*

Johannes Ziegler
ILCB, LPC, AMU & CNRS

How do children learn to read? How do deficits in various components of the reading network affect learning outcomes? How does remediating one or several components change reading performance? In this talk, I will quickly summarize what we know about how children learn to read. I will then present developmentally plausible model of reading acquisition. The model will be used to understand normal and impaired reading development (dyslexia). In particular, I will show that it is possible to simulate individual learning trajectories and intervention outcomes on the basis of three component skills: orthography, phonology, and vocabulary. The work advocates a multi-factorial approach of understanding reading that has practical implications for dyslexia and intervention.

The biology of language

In this advanced class, I will defend the idea that human language is the product of a phylogenetic and ontogenetic history. A history that is singular as a whole (human-unique) but of which some of its components might be shared by other species. Human language is grafted onto other cognitive systems and its particular organization is based on existing biological structures. The cognitive architecture of language depends on a set of biological constraints and opportunities (biomechanical, genetic, neuroanatomical). It is built on a perceiving and acting body -in interaction with the environment- directed towards a goal.

Marie Montant
LPC, AMU & CNRS

Advanced classes

Pascal Belin
INT, AMU & CNRS

Benjamin Morillon
INS, AMU & Inserm

Etienne Thoret
PRISM & AMU

Transverse approach from Sound to Cognition

This course will provide an overview of how sounds are processed by the human brain. The auditory system is the main sense to communicate between one another. Sounds are temporal in essence, and can be as diverse as voice, music, or environmental sounds. All of those carry selective cues that can be analyzed by the human brain, to share linguistic, semantic or emotional information. This course will lead you from the sound dimensions themselves to how cognitively relevant information is extracted and mapped in the cortex.

Computational audition: from psychoacoustics to deep-neural networks
Etienne Thoret

Role of neural oscillations in speech and language perception
Benjamin Morillon

Categorical processing of voice-specific information in the associative auditory cortex
Pascal Belin

Prerequisites:
– Basic notions of neurophysiology: local field potential, functional neuroanatomy
– Basic notions of signal processing: dimensions of a temporal signal (amplitude, time), an oscillatory signal (phase, frequency...). Spectral decompositions: Fourier or time-frequency.

Mixed Models Linear and Logistic

This course will provide both the theoretical background and skills to apply linear and logistic mixed models in R/RStudio. Mixed models are some of the most popular analytical approaches in the human sciences, and the R programming language is widely used in academia. Topics include (but are not limited to) loading and assessing the integrity of your data set (missing values, outliers, etc.), distributional analysis and visualization, mathematical understanding and requirements for an appropriate mixed model, data transformations and handling categorical variables, the specification of fixed and random effects, hierarchical implementations, model application, model checks and optimization, model selection, stepwise approaches/feature elimination, and if time permits, Bayesian implementations of the approach.

Royce Anders
EMC, Lyon 2 Univ.

Sophie Achard
GIN, Grenoble Univ.

Graph construction and analysis

In this course, I will explain the role of graph theory in neurosciences. No strong mathematical background is needed in graph theory, we will learn the main concepts during the first part of the course. Some basic knowledges on statistics may be useful : classical tests such as students t-test, multivariate approaches such as multiple comparisons corrections and PCA. The first course will consist in describing the basics of graph theory. I will give a link to usual toolboxes: networkx and scikit-learn. For the second course, I will describe specific examples of graph analysis in real datasets. Links to tutorials will be given in R and python.

Advanced classes

Chotiga Pattamadilok
LPL, AMU & CNRS

Underlying cognitive and neural mechanisms of the impacts of reading acquisition on speech processing

Literacy acquisition induces massive changes in cognitive functions, brain organization and brain structure, especially within the language system. One of the most important changes is the establishment of strong and automatic connections between the auditory and the visual system. Through these connections, the cognitive processes that are engaged during speech processing become increasingly sensitive to orthographic knowledge, making the two language codes hardly dissociable. During the talk, I will discuss some recent findings on the neural mechanisms underlying the connections between the two language codes and how these recurrent connections progressively lead to more profound changes within both spoken language and visual systems themselves.

Source localization in MEG and EEG

The inverse problem of MEG and EEG consists in estimating neuronal currents within the brain from measures performed at the surface. It allows in particular constructing 'virtual electrodes' that track within each brain region the neuronal activations, with a precision of the millisecond.
Many methods have been proposed to solved this difficult inverse problem. In this lecture, I will review the general principles as well as the different families of methods, with an opening on recent advances in use of sparsity. I will also present the links with multivariate decomposition such as Independent component analysis.

Christian-George Bénar
INS, AMU & Inserm

Mariapaola D'Imperio
LPL, AMU & CNRS

Prosody

In this lecture, we will cover different approaches to prosody and basic elements of current phonological theories.

Topics will include:
- Definitions of prosody
- Components of prosody (including phenomena like stress, intonation, phrasing) and their phonological representation
- How can we examine elements of prosody in the acoustic signal and what are their formal (phonological) relations and representations
- Some perception and cognitive influences on intonation processing.

Advanced classes

Abdellah Fourtassi
LIS, AMU & CNRS

Clément François
LPL, AMU & CNRS

Isabelle Dautriche
LPC, AMU & CNRS

Marianne Jover
PsyClé & AMU

Ricard Marxer
LIS, AMU & CNRS

Interdisciplinary approaches to answer fundamental questions in language acquisition

Recent progress in language-oriented AI (e.g., ChatGPT) has raised new fundamental questions — and renewed old ones – about the nature of human language learning and its use in social interaction. Researchers in language development are, more than ever, faced with theoretical challenges whose answers require close interdisciplinary collaboration, integrating various research methods and levels of analysis. This session will highlight ongoing efforts to gain insights into:

- How the properties of the children's learning environment relate to their linguistic knowledge and its neural correlates
- How innate cognitive biases provide an infrastructure for acquiring various linguistic universals
- How learning language structure relates to – and is influenced by – early language use in social interaction

We will illustrate how such questions are being investigated by:

- Coupling state-of-the-art observational approaches (based on advances in naturalistic recordings and big-data-processing tools) with experimental methods in the lab
- Integrating research methods about learning and development in both human and non-human animal
- Using cutting-edge machine learning tools to provide quantitative theories that bridge across the computational, algorithmic, and implementational levels of language acquisition

Advanced classes

Benoit Favre
LIS, AMU & CNRS

Multimodal language understanding, latest developments

Natural language processing has seen two consecutive revolutions in the past years, with the emergence of pretrained deep learning models such as BERT that can be finetuned on any NLP task, and large language models like ChatGPT, that are general enough to perform a range of tasks without additional training. Those models are limited to text and have no sensibility for other modalities, so can we expect the same developments on other modalities? In this talk, I'll survey the latest developments in deep learning models that account for text in the context of other modalities. In particular, I'll review self-training for speech, image, and video-based models, what to expect from them and what are the associated limitations. I'll also review how the community is trying to bridge the gap between large language models and other modalities through grounding.

Predictive coding

Daniele Schön will give a lecture about the predictive brain : How do we perceive the world surrounding us? What is the role of memory? How many real worlds exist? To what extent our knowledge limits how we study brain functions? I will try to address these and other questions by adopting a musical view of brain functions.

Subjetcs we will talk about : Why Prediction is important, Prediction or reality, Prediction and memory, Prediction and perception, Predictive coding and predictive brain, Mathematical formalization (easy, no worry), Music and predictions, Language and predicitons

No pre-requisite.

Daniele Schön
INS, AMU & Inserm

Yannick Esteve
LIA, Avignon Univ.

Speech processing in the deep learning area: automatic speech recognition, translation, and synthesis

Since the emergence of deep neural network for speech processing, this domain evolves very fast while performances are strongly improved for different tasks.
In this lecture, we will make a survey of the most common neural architectures used for speech recognition, speech translation or speech synthesis: convolutional neural networks, bidirectional long-short memory cells, transformers... and their implementation through wav2vec2.0 models pretrained by self-supervision, through the Whisper model trained by light supervision, or the VITS and Tacotron architecture for speech synthesis.
Then we'll address the question of continuous speech representation, as well as the nature of the information to be captured: linguistic content, prosody, speaker, expressivity, intelligibility, etc.
Last, we will discuss efficiency of such neural architectures and about their accessibility for academics or small and medium-sized enterprises.
The Speechbrain open-source project will be used during the practical.

Advanced classes

Kristof Strijkers
LPL, AMU & CNRS

Cognitive and neural dynamics of basic conversation

Traditionally, psycho- and neurolinguistic research treat the production and perception of language separately. However, the vast majority of our daily language use occurs during conversation, where the production and perception of speech need to be in tight orchestration. Consequently, language models should be able to explain the interplay between production and perception in order to understand the nature of language processing within the context of conversation. Interestingly, in the last decade we see that research exploring conversational dynamics, and studying speech production and perception concurrently is on the rise. In this advanced course I will highlight some important research in the cognitive neuroscience of conversation and production-perception interactions, what we have learned concerning the cognitive neural dynamics underpinning basic conversation, and which future endeavours should be considered in order to move this fascinating domain of research forward.

Language in the brain and algorithms

Deep learning has recently made remarkable progress in natural language processing. Yet, the resulting algorithms fall short of the efficiency of the human brain. To bridge this gap, we here explore the similarities and differences between these two systems using large-scale datasets of magneto/electro-encephalography (M/EEG), functional Magnetic Resonance Imaging (fMRI), and intracranial recordings. After investigating where and when deep language algorithms map onto the brain, we show that enhancing these algorithms with long-range forecasts makes them more similar to the brain. Our results further reveal that, unlike current deep language models, the human brain is tuned to generate a hierarchy of long-range predictions, whereby the fronto-parietal cortices forecast more abstract and more distant representations than the temporal cortices. Overall, our studies show how the interface between AI and neuroscience clarifies the computational bases of natural language processing.

Jean-Rémi King
ENS-PSL & CNRS

Cheryl Frenck-Mestre
LPL, AMU & CNRS

Bilingualism

The present series of lectures will examine online processing in a late-learned language, at various levels or representation (from phonolgy to syntax). Current theories of L2 processing will be confronted with data obtained via the recording of electrophysiology (ERPs), eye movements and fMRI in the aim of elucidating common versus distinct mechanisms that underlie L1 and L2 processing in adults.

CREx

Thierry Legou
CREx, ILCB, AMU & CNRS

Valérie Chanoine
CREx, ILCB, AMU & CNRS

Christelle Zielinski
CREx, ILCB, AMU & CNRS

Deirdre Bolger
CREx, ILCB, AMU & CNRS

Franziska Geringswald
CREx, ILCB, AMU & CNRS

CREx

The ILCB Center of Experimental Resources (CREx) is a team of engineers specialized in scientific computing and data analysis. The CREx plays a central role within the ILCB by providing support to all of its members and across all of its topics of research.

Drawing on the complementary profiles of its members, the CREx team supports the ILCB's diverse and inter-disciplinary projects, all of which are centred around the study of the language processes related to speech production, perception and cognition.

Thanks to their collaborations with the various experimental platforms within the ILCB over the past 10 years, the CREx has developed extensive skills including:

- The scientific instrumental set-up,
- The development of experimental paradigms (adapted to neuroimaging protocols, virtual reality environment, as well as web-based platforms for online experiments),
- The data pre-processing (in conjunction with signal or image processing and quality assurance),
- The processing of behavioural, eye-tracking, neuroimaging (MRI) and neurophysiological (EEG, intracranial EEG, HD-EEG, MEG) data,
- The data valorisation (data visualisation and scientific writing).

The CREx organizes and participates in several training courses every year, these include the MASCO ("Master Sciences Cognitives") cursus, but also courses devoted to ILCB members in the context of supported projects.

This year, the CREx team will present a sample of their recent work in the form of an interactive installation...Curious? ...Well come and meet us!!

Keynote

Robert French
Emeritus Research Director at the CNRS
Laboratory for Research on Learning and Development, University of Bourgogne

The Brave New World of Artificial Intelligence

Everyone is talking about Artificial Intelligence these days: automatic image recognition, autonomous vehicles, ChatGPT, DALLE-E-2 and their potentially transformative effects on society. We even hear regularly about The Singularity, the fateful day when computers will become smarter than us, widening the intelligence gap between us and them so far that the survival of the human race might be endangered. Some respected scientists, such as Eliezer Yudkowski, go so far as to say that if current AI development continues, the human race will be wiped out by intelligent machines. Less radical are a growing number of other well-known and respected computer scientists, starting with Ray Kurzweil, chief scientist at Google, who believe that "The Singularity is near" and that we need to start preparing for it. The "Godfather of AI", Geoff Hinton, one of the inventors in 2012 of the current systems that drive systems like GPT-4, has recently quit Google to be free to warn of the coming dangers of continuing AI development. In contrast, other leading researchers (Rodney Brooks, Melanie Mitchell, Gary Marcus, etc.) think that computers still have a long way to go before they achieve what one could reasonably call intelligence and understanding. My opinion on the matter lies somewhere in the middle. But no one could reasonably deny that recent advances in AI, and, specifically, in ChatGPT, Midjourney, etc., are both promising and worrisome. With the help of examples from everyday life, I hope to show that there are still significant difficulties to overcome, whether it be in the field of image recognition or text/image generation and that these difficulties are related to the lack of understanding of these programs. But what exactly does "understanding" consist of? The key question for AI in the 21st century will be to know to what extent these programs will be able to acquire an understanding of the world similar to ours relying only on billions of texts, images and sounds drawn from the Internet, without ever having perceived the world as we perceive it, through our visual, tactile, olfactory, auditory, and gustatory senses. I believe that there is still a significant distance to be travelled before these programs will achieve what we would call true AI, even if the AI that eventually emerges is not necessarily identical to human intelligence.

Fenna Poletiek
Chaire IMéRA-ILCB
Institute of Psychology, Leiden University, Netherlands

Language learning in the lab

Language learning skills have been considered a defining feature of humanness. In this view language cannot be acquired by mere associative or statistical learning processes, only, like many other skills are learned by human and non-human primates during development. Indeed, the high (recursive) complexity of human grammars have been shown to make them impossible to learn by exposure to language exemplars only.
Some research suggests, however, that at least some statistical learning is recruited in language acquisition (Perruchet & Pacton, 2006). And primates have been shown to mimic complex grammatical patterns after being trained on a sequence of stimulus responses (Rey et al., 2012). We performed series of studies with artificial languages in the lab, to investigate associative and statistical learning processes that support language learning. The results thus far suggest a fine tuned cooperation between three crucial features of the natural language learning process: first, learning proceeds 'starting small' with short simple sentences growing in complexity and length. Second, early language is not random but is biased towards descriptions of events in the world (the dog barks occurs more often than the dog talks). Finally, language structure is recursive and hierarchical, i.e. it is a system of (reusable) building blocks. Taken together, language learnability might result from a narrow fit between a biased input, simple associative and statistical learning processes and recursive complexity. Surprisingly, in our account, complexity is a facilitative feature rather than a difficulty.

Cross-cutting topics

Patrick Lemaire
LPC, AMU & CNRS

Emotion and cognition

How and when do emotions influence cognition? Do positive and negative emotions influence cognitive performance the same way and under the same conditions? Which emotional dimension (valence: negative vs. positive; intensity: low-/high-arousal) is most critical in effects of emotions on cognition? How do these effects of emotions on cognitive performance change with age and other individual characteristics (e.g., anxiety, phobia, schizophrenia, etc.)? What are the mechanisms responsible for the effects of emotions on cognition and are these mechanisms the same in children, young and older adults? Over 30 years of research have addressed these issues. We now know how different emotions and emotions of different intensities influence participants' performance in wide areas of cognition, including both domain-general domains (e.g., attention, memory, reasoning, decision making, problem solving and domain-specific domains (e.g., language, face processing, numerical cognition, music, spatial cognition). In this talk, I will present what we know and new research perspectives on how emotions affect cognition.

How do we understand each other?

A neuro-cognitive model of comprehension integrating shallow and deep processing.

Philippe Blache
ILCB, LPL, AMU & CNRS

Understanding is a complex task, requiring the integration of various information making it possible to go from sound and gesture to sense. The classical view is based on the idea that each level of information carries pieces of meaning that need to be combined in order to build a semantic representation of the text or the message. But we also know that this complex process is extremely fast and robust, done in real time during conversations. Numerous studies have shown that such robustness and efficiency are made possible by several mechanisms: the ability to predict, the possibility of directly accessing entire blocks of meaning (non-compositionality) and the possibility of performing a "good-enough" processing, sufficient to allow comprehension. These mechanisms, by substituting to the "standard" one, facilitate the processing of accessing to the meaning. However, there is no model explaining when these facilitation mechanisms are triggered and how they inhibit the application of standard processing by substituting for it. The problem is that in classical models, these two types of treatment, shallow and superficial, are clearly distinct and rely on completely different mechanisms (and routes).

In this presentation, I propose to draw the basis of a model proposing a single processing loop integrating both facilitation mechanisms and the standard processing. This model is based first on a unique representation of linguistic units, whether they are lexical or more complex, each carrying a piece of meaning. It then integrates activation and prediction mechanisms to explain how access to long-term memory (in particular lexical access) may not be systematic. Finally, it explains how meaning is constructed in an incremental but non-linear way, by the composition of units of variable granularity (from word to construction). By using unification as a core mechanism for accessing the memory and building the representations, this model is in the framework of "Memory, Unification and Control" (MUC) paradigm proposed by Peter Hagoort.

Organizing committee

Arnaud **Rey**
LPC, AMU & CNRS

Thomas **Schatz**
LIS, AMU & CNRS

Caterina **Petrone**
LPL, AMU & CNRS

Johannes **Ziegler**
ILCB, LPC, AMU & CNRS

Adrien **Meguerditchian**
LPC, AMU & CNRS

Christian-George **Bénar**
INS, AMU & Inserm

Jean-Marc **Freyermuth**
I2M, AMU & CNRS

Philippe **Blache**
ILCB, LPL, AMU & CNRS

Nadéra **Bureau**
ILCB & AMU

Sabrina **Rodrigues**
ILCB & AMU