Radboud Universiteit

Radboudumc

DONDERS INSTITUTE

NWO

MAX PLANCK INSTITUTE FOR PSYCHOLINGUISTICS

UNIVERSITY OF AMSTERDAM

Maastricht University

UMC Utrecht

Universiteit Leiden
The Netherlands

TILBURG UNIVERSITY

For more information visit our website hils2024.nl

LANGUAGE in INTERACTION

Highlights in the Language Sciences

Conference | Nijmegen | July 8-11, 2024

Program of events to mark the conclusion of our 10-year Gravitation Program, and the research it supported in genetics, neuroscience, psychology, linguistics and computational modeling

Welcome to HILS2024

Welcome to the Highlights in the Language Sciences (HILS) conference. The conference is organized by the Language in Interaction program, supported by a 10 year grant from the Dutch Research Council (NWO) and the Dutch Ministry of Science and Education (for details, see http://languageininteraction.nl). This grant brought together a large number of researchers who worked on multiple aspects of the human language capacity in multiple universities and institutes within the Netherlands. Researchers from different fields of research, including linguistics, cognitive science, computational modeling, neuroscience, and genetics teamed up to address some of the Big Questions for our field, in an attempt to understand key aspects of the human language faculty at multiple scales of organization. The program is based on the conviction that progress in this domain of science requires interaction between researchers from very different fields, with the aim to find common ground between them. This conference marks the end of the grant.

Notes

The conference promises to provide an excellent overview of the current state of the art in the language sciences. In many ways language is a multi-headed beast. Moreover the boundaries between language and other cognitive functions are fuzzy. The program exemplifies these characteristics.
In addition, due to the recent developments of Large Language Models in AI, *homo sapiens* might no longer be unique in having a sophisticated capacity for language. This development is also reflected in the program. In many ways, we have entered exciting times for the language sciences. No doubt, language is a central aspect of human life and culture. Hence, understanding its foundations is crucial for the quest of what makes us human and for the improvement of the *condition humaine*.

Peter Hagoort
Program director of the Language in Interaction consortium

Program Contents

Building Map

Monday

Chair: Peter Hagoort

Welcome by Peter Hagoort
09:00 am - 09:30 am
Christopher Summerfield
9:30 am - 10:10 am
Katrin Amunts
10:10 am - 10:50 am

Coffee break
10:50 am - 11:20 am

David Poeppel
11:20 am - 12:00 pm
LI presentation: Simon Fisher
12:00 pm - 12:30 pm

Poster session and lunch break
12:30 pm - 2:00 pm

Chair: Roshan Cools

Mona Garvert
2:00 pm - 2:40 pm
Andre Bastos
2:40 pm - 3:20 pm

Coffee break and poster session
3:20 pm - 4:20 pm

Uri Hasson
4:20 pm - 5:00 pm
LI presentation: Ioanna Zioga
5:00 pm - 5:30 pm

Network drinks & bites
5:30 pm - 7:00 pm

Tuesday

Chair: James McQueen

Stanislas Dehaene
09:00 am - 09:40 am
Barbara Kaup
9:40 am - 10:20 am

Coffee break
10:20 am - 11:50 am

Marc Brysbaert
10:50 am - 11:30 am
Vera Demberg
11:30 am - 12:10 pm
LI presentation: Antje Meyer
12:10 pm - 12:40 pm

Poster session and lunch break
12:40 pm - 2:00 pm

Chair: Aslı Özyürek

Morten Christiansen
2:00 pm - 2:40 pm
Melissa Duff
2:40 pm - 3:20 pm

Coffee break and poster session
3:20 pm - 4:20 pm

Rachel Jack
4:20 pm - 5:00 pm
LI presentation: Marieke Woensdregt
5:00 pm - 5:30 pm

BBQ at Grotius terrace
5:30 pm - 8:00 pm

Poster Session D - Tuesday 3:20 pm - 4:20 pm

Demonstration Letterprins - Esther Steenbeek-Planting D -1

Language and vision in conceptual processing: Multilevel analysis and statistical power - Pablo Bernabeu, Dermot Lynott and Louise Connell D1

Language background-related variability in processing pronouns of address in Dutch - Maria den Hartog D2

Recall, generalisation and the role of declarative memory in the acquisition of new L2 morphology: A pilot study - Giulia Bovolenta and John N. Williams D3

Foreign Language Effect on Mental Imagery: Evidence from Brain Potentials and Psychophysiological Responses - Fei Gao D4

The importance of implementing new technologies, digital learning tools, and social media in the language classroom – The case of French as a foreign language (FLE) - Marine Pédéhour-de Wit D5

Individual Differences in Leveraging Regularity in Emergent L2 Readers in Rural Côte d'Ivoire - Henry Brice, Benjamin Zinszer, Danielle Kablan, Fabrice Tanoh and Kaja J. Jasińska D6

Exploring Phonetic Variations in Daily Turkish Use among Arab Students in Turkey - Ahmed Metwally Abdalla, Ahmed Metwally Abdalla and Ahmed Metwally Abdalla D7

Neural signature of indirect reply processing while listening to L1 and L2 dialogues - Angélica Gutiérrez Cisneros, Angèle Brunellière and Alice Foucart D8

Investigating cognate effects across different writing scripts: the case of Brazilian Portuguese-English-Korean multilinguals - Luiza de Melo Carvalho and Mailce Borges Mota D9

Language similarity shapes adaptation to multi-language environments - Jingkang Wang, Andrea Olguin and Mirjana Bozic D10

Word Frequency and Morpheme Frequency Effect in Naming Mandarin Chinese Compounds: More than a Replication - Jiaqi Wang, Rinus Verdonschot and Niels Schiller D11

Developmental Changes in Spectral Power Bands and Language Skills: An infant EEG study - Anne Buizer D12

Wednesday

Chair: Raquel Fernández

Tal Linzen
09:00 am - 09:40 am

Alona Fyshe
9:40 am - 10:20 am

Coffee break
10:20 am - 10:50 am

Roger Levy
10:50 am - 11:30 am

LI presentation: Willem Zuidema
11:30 am - 12:00 pm

Joshua Hartshorne
12:00 pm - 12:40 pm

Lunch break
12:40 pm - 2:00 pm

Afternoon program in the historic city of Nijmegen
2:00 pm - 6:00 pm

Program on the following page.

Thursday

Chair: Ivan Toni

Kate Watkins
09:00 am - 09:40 am

Ghislaine Lambertz-Dehaene
9:40 am - 10:20 am

Coffee break
10:20 am - 10:50 am

Sophie Valk
10:50 am - 11:30 am

LI presentation: Stephanie Forkel
11:30 am - 12:00 pm

Lunch break
12:00 pm - 1:00 pm

Afternoon in honor of Peter Hagoort
Chair: Pienie Zwitserlood

Program on the following page.

Network drinks & bites
5:30 pm - 7:00 pm

Wednesday cont...

Afternoon program in the historic city of Nijmegen
2:00 - 6:00 pm
Registration required

Join us on an historical walk of Nijmegen, the oldest city in the Netherlands.* The conference organizers will provide transportation via bus to the city center, and the walking tour will begin from there. Following the tour, participants are invited to spend an evening at a uniquely Nijmeegse, summer-long standing festival called De Kaaij. Here, attendees can enjoy live music, a variety of food options (with no shortage of vegan or vegetarian choices), and drinks. De Kaaij is located in Nijmegen harbor.

*Contested by Maastricht and complicated by opinions concerning Roman city rights.

Thursday cont...

Afternoon in honor of Peter Hagoort
Chair: Pienie Zwitserlood

Opening by Pienie Zwitserlood
1:00 pm - 1:10 pm
Ping Li
1:10 pm - 1:35 pm
Jeffrey Binder
1:35 pm - 2:00 pm
Ron Mangun
2:00 pm - 2:25 pm

Coffee break
2:25 pm - 2:55 pm

Manuel Carreiras
2:55 pm - 3:20 pm
Edward de Haan
3:20 pm - 3:45 pm
Marta Kutas
3:45 pm - 4:10 pm

Coffee break
4:10 pm - 4:40 pm

Ulman Lindenberger
4:40 pm - 5:05 pm
Angela Friederici
5:05 pm - 5:30 pm
Pienie Zwitserlood
5:30 pm - 5:45 pm

Four orange markers indicate important locations

Monday Speaker Abstracts
Morning Session Chair: Peter Hagoort

9.30 Christopher Summerfield
University of Oxford

Curriculum learning for memory and inference problems

Humans learn faster when information is temporally structured in time. For example, students rarely study French and Spanish in the same class, because this would be confusing. Neural networks, by contrast, tend to learn best from diverse data that is well mixed over training trials. Why is this? We currently lack computational theories of why training curricula might work in humans and other animals, especially for supervised learning problems. Here, we study curriculum learning using tasks that involve memorisation, the learning of relational graphs (or cognitive maps), and more complex video games. We show that curricula that interleave structure and content (e.g. grammatical rules and vocabulary items) facilitate rapid and generalisable learning in humans, but not neural networks, including transformer-based models. We offer a sketch of a general theory of how to accelerate human learning.

10.10 Katrin Amunts
Research Center Jülich

Anatomical landscapes of language

Our understanding of the neuroanatomical basis of language is very much influenced by the seminal work of Paul Broca and Carl Friedrich Wernicke. However, concepts of language as a cognitive function have significantly changed since then, and, from an anatomical perspective, the concepts of Broca's and Wernicke's regions are ill-defined. Recent cytoarchitectonic analyses and 3D maps show a much more detailed parcellation of both regions and neighboring areas, with specific contributions to language-related tasks. Beyond brain mapping, they characterize their microstructure

Poster Session C - Tuesday 12:10 pm - 12:40 pm

including cell densities and laminar pattern, and are a tool to compare this with receptorarchitecture, connectivity, genetic data or functional activations in a multi-modal approach. A prominent feature of language related regions is their considerable intersubject variability at the micro and the macro level, and, for some of its features, inter-hemispheric asymmetry. The Julich-Brain Atlas as part of the EBRAINS research platform provides maps and analysis tools to the international research community to distinguish the different components of the language network, to contribute to brain medicine related to language deficits, e.g. in tumor patients, and, more general, to get a deeper understanding about the relationship of brain structure and function.

11.20 David Poeppel

New York University, Strüngmann Institute Frankfurt

Rhythms and Algorithms: From Vibrations in the Ear to Abstractions in the Brain

The brain has rhythms – and so do music and speech. Recent research reveals that the temporal structure of speech and music and the temporal organization of various brain structures align in systematic ways. The role that brain rhythms play in perception and cognition is vigorously debated and continues to be elucidated through neurophysiological and computational studies of various types. I describe some intuitively simple but surprising results that illuminate the temporal structure of perceptual experience. From recognizing speech and planning speech to building abstract mental structures, how the brain constructs and represents time reveals unexpected puzzles in the context of speech perception and language comprehension.

Monday Speaker Abstracts

12.00 Simon Fisher
Max Planck Institute Nijmegen

Genomic investigations of speech, language, and reading

The use of spoken and written language is a fundamental human capacity, involving the intertwining of nature and nurture. Decades of research have established that interindividual differences in reading- and language-related skills are influenced by variation at the DNA level. However, the relevant genetic architecture is complex, heterogeneous, multifactorial, and challenging to study in a robust manner. I will give an overview of the promise and pitfalls in this area of science, discussing how advances in molecular technologies and analytical approaches, coupled to new developments in trait characterization, have begun to transform the field. Data from such studies are integrated with emerging findings from neuroimaging genomics and investigations of gene expression patterns in postmortem brain tissue. I will illustrate with examples of work from the Big Questions of the Language in Interaction consortium.

Afternoon Session Chair: Roshan Cools

14.00 Mona Garvert
Julius-Maximilians-Universität Würzburg

Hippocampal and prefrontal representations enabling flexible cognition

In our ever-changing world, the ability to adapt to novel situations is essential. This adaptability often involves leveraging our past experiences to navigate new challenges. For example, when choosing from a menu in an unfamiliar restaurant, we instinctively draw upon past dining experiences to guide our decision. Such generalization is a cornerstone of adaptive behavior, allowing us to make informed decisions without relearning strategies for every new scenario. In this talk, I explore how the human brain enables such behavior. I will demonstrate that the brain constructs hippocampal cognitive maps, traditionally known for encoding

spatial relationships, to also represent other types of relational knowledge, providing a flexible foundation for generalization and novel inference. In high-dimensional decision-making scenarios, the orbitofrontal cortex selectively activates relevant cognitive maps tailored to the specific task, showcasing the brain's dynamic information processing capability. Additionally, our research reveals that with time and consolidation, the brain forms more abstract relational maps, which transcend specific stimuli and reflect the broader relational structure of experiences. In summary, our findings illustrate the remarkable adaptability of neural representations in the human brain. They demonstrate how these representations are not just static archives of past experiences but are dynamic tools actively reshaped to aid decision-making and behavior in ever-changing environments.

14.40 Andre Bastos

Vanderbilt University

Multi-laminar, multi-area recordings in the non-human primate brain suggest Predictive Coding is implemented via Predictive Routing

To understand the neural basis of cognition, we must understand how top-down control of bottom-up sensory inputs is achieved. We have marshaled evidence for a canonical cortical control circuit that involves rhythmic interactions between different cortical layers. By performing multiple-area, multi-laminar recordings, we've found that local field potential (LFP) power in the gamma band (40-100 Hz) is strongest in superficial layers (layers 2/3), and LFP power in the alpha/beta band (8-30 Hz) is strongest in deep layers (layers 5/6). We call this pattern the spectrolaminar motif. We have found evidence that this spectrolaminar motif is preserved in different non-human primate species as well as humans, but is less preserved between primates and mice. The gamma-band is strongly linked to bottom-up sensory processing and neuronal spiking carrying stimulus

information, while the alpha/beta-band is linked to top-down processing. Deep layer alpha/beta Granger causes that in superficial layers, and is negatively coupled to gamma. These oscillations give rise to separate channels for neuronal communication: feedforward for the gamma-band, and feedback for the alpha/beta band. Attention, working memory, and prediction processing all involve modulation of gamma and alpha/beta synchronization within and across areas. These rhythmic interactions breakdown during anesthesia-induced unconsciousness. Based on these observations, we hypothesize that the interplay between alpha/beta and gamma synchronization is a canonical mechanism to enable cognition and consciousness.

16.20 Uri Hasson

University of Princeton

Deep language models as a cognitive model for natural language processing in the human brain

Naturalistic experimental paradigms in cognitive neuroscience arose from a pressure to test, in real-world contexts, the validity of models we derive from highly controlled laboratory experiments. In many cases, however, such efforts led to the realization that models (i.e., explanatory principles) developed under particular experimental manipulations fail to capture many aspects of reality (variance) in the real world. Recent advances in artificial neural networks provide an alternative computational framework for modeling cognition in natural contexts. In this talk, I will ask whether the human brain's underlying computations are similar or different from the underlying computations in deep neural networks, focusing on the underlying neural process that supports natural language processing in adults and language development in children. I will provide evidence for some shared computational principles between deep language models and the neural code for natural

language processing in the human brain. This indicates that, to some extent, the brain relies on overparameterized optimization methods to comprehend and produce language. At the same time, I will present evidence that the brain differs from deep language models as speakers try to convey new ideas and thoughts. Finally, I will discuss our ongoing attempt to use deep acoustic-to-speech-to-language models to model language acquisition in children.

17.00 Ioanna Zioga

Donders Institute

Alpha and beta oscillations shape language comprehension and production

Alpha oscillations are thought to facilitate processing through the inhibition of task-irrelevant networks, while beta oscillations are linked to the putative reactivation of content representations. Can the proposed role of those brain rhythms be generalized from lower-level to higher-level, linguistic processes? To this end, we performed two magnetoencephalography (MEG) studies. In the first study, Dutch native speakers listened to stories in Dutch and French while MEG was recorded. We used dependency parsing to identify three dependency states at each word: the number of (1) newly opened dependencies, (2) dependencies that remained open, and (3) resolved dependencies, as proxy measures for high-level cognitive processes. Forward models showed that dependency features predict alpha/beta power modulations in language-related regions beyond low-level linguistic features, but only in the native language. In the second study, we constructed a novel paradigm in which participants produced an exemplar or a feature of a target word embedded in spoken sentences (e.g., for the word *tuna* an exemplar from the same category—seafood—would be *shrimp*, and a feature would be *pink*). A visual cue indicated the task—exemplar or feature. Participants were slower, gave more variable and semantically distant answers for features, due to lower association