

NEW LAB MEMBERS

Jeremy Louis

Cartable Fantastique/Social Open Space

Hello, I'm Jeremy Louis, a postdoctoral researcher working with Dr Caroline Huron on the Horizon Europe project Lab2school4all. My work focuses on two key aspects: adapting math exercises for children with dyspraxia and gathering qualitative data through surveys and focus groups. These data will provide insight into how young adults and parents of children with dyspraxia, as well as teachers and healthcare professionals, evaluate adapted exercises in math and language learning across Ireland, the UK, Italy, and France.



This project builds on my doctoral research, as both center on optimizing learning processes in children. From the general population to the specific needs of children with dyspraxia, this work bridges cognitive science (specifically psychology, in my case) and the classroom.

I also previously explored the impact of integrating AI tools into teaching, examining their effects on teachers, students, and parents alike.

Beyond research, I love exploring, whether that means traveling across Europe and beyond, or discovering hidden spots around Paris.

Thibault Delval

Rose Bourges

Philipp Werthmann

Bruna Lopes

ACHIEVEMENTS, PUBLICATIONS

Initial organization and progressive expansion of the math-responsive brain network during the first school years

T. Morfisse, S. Becuwe, M. Palu, C. Potier-Watkins, G. Dehaene-Lambertz, & S. Dehaene,

The neural mechanisms by which the developing brain acquires higher mathematical concepts from elementary intuitions remain poorly understood. Through a large-scale longitudinal functional MRI study of children from preschool through first and second grade, we tracked how neural responses to mathematical and nonmathematical statements change in the first 2 y of formal schooling, and we used these data to evaluate several theories of developmental change. Before school, when listening to math statements, children already engaged an adult-like cortical network, with partial specialization for geometry. Over the first 2 y of school, we observed an overall increase in math-related activation, a small recruitment of additional neural territory, reduced activation for facts that get better known, and a small overall increase in the dimensionality of representational space. fMRI responses to individual sentences suggest that these mechanisms, particularly in left inferior frontal gyrus and bilateral intraparietal sulcus, all contribute to children's growing mastery of mathematical concepts.

[PNAS](#)

Impact of Education and Music Training on the Development of Abstract Thinking in the First Years of Schooling.

Théo Morfoisse, Séverine Becuwe, Marie Palu, Cassandra Potier Watkins, Ghislaine Dehaene-Lambertz, Stanislas Dehaene

Plato's Republic, Einstein's Theory of relativity, Vivaldi's Four Seasons are all remarkable examples of humans' unique ability to create and manipulate complex abstract structures, whether in language, mathematics, or music. Yet the mechanisms by which children develop such abstract thinking, and the role of education and structured experiences such as musical practice in shaping these abilities remains unclear. To explore these questions, we conducted cross-sectional behavioral experiments with 528 children aged 4 to 8, spanning four educational grades, half of whom participated in a violin training program, from age four. Two experiments examined how children encode, process, and compress auditory sequences and visual patterns, while a third examined their sensitivity to geometric regularities. Our results reveal the emergence of symbolic reasoning as early as the start of formal schooling, with deeper abstraction as a function of grade. By first grade, children encoded complex auditory sequences within a Language of Thought (LoT) similar to adults. Additionally, when confronted with quadrilaterals, children showed increasing sensitivity to geometric regularities, suggesting a developmental transition from perceptual to symbolic reasoning. However, we did not observe significant impact of musical practice on abstraction abilities across any of the domains tested. We discuss whether and how the impact of education and extracurricular activities such as music could be enhanced.

[Open Mind 2026](#)

A Journey Into a Traveler's Mental Map: Duration, Distance, and Speed Experienced in High-Speed Trains.

Nédélec, Y., Bordas, R., Sam-Mine, D., Lamprou Kokolaki, M., Beirnaert, B., Vallet, W., Lhuillier, S., Grison, E., Lemaitre, G., Morgagni, S., Gyslinck, V. and van Wassenhove, V.

Our study investigates how high-speed transport affects humans' perception of time, space, and speed. We tested 247 passengers traveling on the French Paris-Lyon high-speed train (TGV) who estimated the traveled distance, elapsed duration, and instantaneous and average speeds, while rating their confidence, felt speed of time passage, and emotional state. Environmental variables in this In Situ design included seating orientation (forward or backward) and train acceleration (positive, null [constant high-speed], or negative [deceleration]). Our findings show that participants' magnitude (duration, distance) estimations scaled with magnitudes. Estimations also exhibited typical features such as central tendency, which interestingly scaled to the midpoint of the journey (~69 min) rather than the expected ~15 min. Surprisingly, we found no influence of emotions or felt speed of time passage on magnitude and speed estimates. Instead, participants' prior knowledge of the journey's total duration and distance better explained their magnitude estimations than their on-the-fly speed estimates. Seating orientation did not significantly affect estimations, whereas acceleration partly did. Participants demonstrated reliable metacognitive ratings of their duration and instantaneous speed estimates, but not of their distance and average speed estimates. Altogether, our results show that in passive high-speed transport, passengers may rely on cognitive heuristics (mental maps) rather than sensorimotor integration (path integration) to estimate magnitudes. We discuss the implications of our work for understanding mental representations of magnitudes and speed in real-life situations.

[Cognitive Science](#)

Long-horizon associative learning as a unifying framework for statistical learning across scales

Benjamin, L., Fló, A., Al Roumi, F., & Dehaene-Lambertz, G.

Sensory inputs are rich with temporal patterns that unfold across multiple timescales. Uncovering these regularities is essential for anticipating future events and navigating the environment efficiently. Numerous models have been proposed to account for learning at specific temporal scales; however, they are often designed in isolation and rely on narrowly tuned statistical measures, limiting their generalizability to other paradigms. In contrast, humans typically learn without prior knowledge of the underlying structure or the relevant timescale at which regularities occur. Here, we

present a unifying account of statistical learning that spans a wide range of temporal dependencies, from adjacent and nonadjacent transitions to complex network structures. This model, long-horizon associative learning, offers a biologically grounded implementation of the successor representation, or equivalently, the free energy minimization model. Reanalyzing data from 11 previously published studies, we show that a single neural mechanism captures both local statistical regularities and higher-order structural properties. This mechanism rests on graded temporal overlap of associative traces and is governed by a single free parameter (β). This initial domain-general associative learning process, emerging from the graded structure of associations, may later scaffold to higher-level operations such as grouping, categorization, rule abstraction, and memory formation. Overall, this framework offers a conceptual synthesis that bridges disparate strands of the statistical learning literature and reframes apparent paradigm-specific effects as different expressions of a common underlying computation.

[Proceedings of the National Academy of Sciences, 123\(31\), e2513423123.](#)

Human fMRI at 11.7T: Assessing Feasibility, Stability, and Reliability on the Iseult Scanner

Joseph Obriot, Zaineb Amor, Matthias Serger, Rüdiger Stirnberg, Philipp Ehses, Malte Riedel, Tony Stöcker, Klass P Prüssmann, Shajan Gunamony, Son Chu, Alexis Amadon, Alexandre Vignaud, Vincent Gras, Florent Meyniel, Franck Mauconduit, Caroline Le Ster, Nicolas Boulant

Ultra-high-field MRI promises major gains in BOLD sensitivity but introduces severe challenges such as RF field inhomogeneity, B0 field inhomogeneity, motion and vibration-induced field variations. We report the first whole-brain resting-state and task-based fMRI experiments at 11.7T. A 3D-EPI sequence was optimized using tailored parallel-transmit RF pulses, gradient reshaping to suppress vibration-induced B0 fluctuations, and prospective motion correction using servo navigation combined with retrospective phase equalization (PEERS). Four participants were scanned at 11.7T with whole-brain 1.2 mm isotropic resolution with servo navigation and PEERS that considerably reduced residual motion and increased temporal SNR. The Default Mode Network in resting state could be detected and a physiological-noise-dominated regime was identified. Four additional but different participants were scanned at 7T for tSNR comparison and validation of the protocol, data quality and processing pipeline. Task-based fMRI likewise was conducted at 11.7T and yielded robust, spatially specific activations across motor, visual, mathematical, and language networks, again with improved sensitivity and cleaner BOLD responses when using servo navigation and PEERS. These results demonstrate the feasibility and reliability of whole-brain human fMRI at 11.7T and constitute a first quality control milestone to further increase resolution at that field strength.

[Imaging Neuroscience 2026](#)

Comprehensive profiling of brain dynamics during anesthesia across phylogeny

Luppi, Andrea I., Uhrig, Lynn, Tasserie, Jordy, Castro, Pablo, Signorelli, Camilo M., Cofre, Rodrigo, Destexhe, Alain, Jarraya, Bechir, Misic, Bratislav

The behavioral effects of anesthetics are highly conserved across species, hinting at shared and fundamental underlying mechanisms. Here we compile a dataset of multiscale neural activity during wakefulness and anesthesia, encompassing human, macaque, marmoset, mouse, zebrafish and nematode. Applying massive feature extraction, we characterize local neural dynamics across >6,000 time-series features. This reveals a conserved dynamical profile of anesthesia across species, characterized by shorter intrinsic timescales of neural activity and dampened inter-regional synchrony. Deep-brain stimulation of the macaque centromedian thalamus reverses this profile and restores behavioral responsiveness. This conserved dynamical phenotype covaries with conserved transcriptional profiles of excitatory and inhibitory neurotransmission. Biophysical modeling provides a potential mechanistic link between the macroscale dynamical phenotype of anesthesia and microscale effects of key molecular targets on the timescales of synaptic excitation and inhibition. These analyses reveal a shared neural endpoint of anesthesia: across species and scales, anesthetics induce spatiotemporal isolation of local neural activity.

Nature Neuroscience - <https://doi.org/10.1038/s41593-026-02460-4>

Congrats to **Ana Martin** for her ANR ONLOGIC

Funding : ANR JCJC (Agence nationale de la recherche - Jeunes Chercheuses et Jeunes Chercheurs)

From 2026 to 2029, this project will investigate the foundations of logical reasoning from a developmental perspective. Using non-verbal tasks, eye-tracking and EEG in infants, and MEG in adults, we will study how humans represent alternatives, apply basic logical rules, and reason about abstract concepts. Our goal is to understand how these abilities emerge and how they are represented in the brain.

Congrats to **Joao Barbosa** for his ERC [DISCONTROL](#) (DIScovery and CONTROL of flexible neural architectures)

Alireza Karami won the Glushko Dissertation Prize for his 2025 PhD Thesis “The Representation Of Numerosity In The Human Brain And Machines” from University of Trento

On 10 June 2026, President Emmanuel Macron and Brigitte Macron laid the first stone of the Robert-Debré Institute for the Child's Brain, on the grounds of the Robert-Debré hospital. Due to open in 2028, the 14,000 m² building will bring together clinical care, research, and families to advance the understanding and treatment of neurodevelopmental disorders in children.

[Une première pierre pour le bâtiment de l'IHU en présence du Président de la République | Institut Robert-Debré du Cerveau de l'Enfant](#)



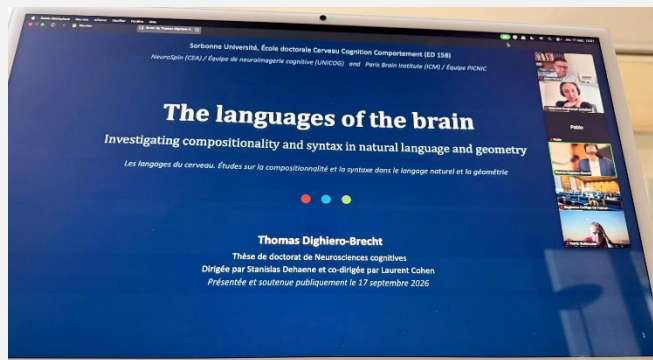
September 11th

Théo Morfoisse defended his PhD with a thesis entitled “Impact of musical practice, schooling and education on the development of symbolic systems: a multimodal neuroimaging investigation”.



September 17th

Thomas Dighiero defended his PhD with a thesis entitled ‘The languages of the brain: investigating compositionality and syntax in natural language and geometry’.



REMINDER OF THE MONTH

We now have access to two new tools: Inserm Assistant and Inserm Chat.

1. Inserm Assistant: Best for daily tasks like writing emails or summarizing documents. It is very simple to use.
2. Inserm Chat: Best if you need more advanced features, like complex analysis or using Python code.

Some info

- They are free for all staff.
- They are secure as they are "sovereign" tools. This means they run on INSERM's own servers. Your data and documents stay private and are not shared on the public web.
- They are made for us: They are specifically adapted for research work.

This is the starting point: <https://portail.nhds.inserm.fr/my.policy>

You can also find training classes dedicated to AI here: <https://eformation.inserm.fr/login/index.php>

Newsletter UNICOG September 2026

A lab is defined by the people who work in it