the sense
innovation and research center

edition
March 23

newsletter 01

Inside The Sense 6–11

Neuroscience and Education

A focus on the field of neuroscience and education, by Dr. Juliane Schneider and Prof. Paul Matusz.

Interview

Let's head for South Africa and the behaviour analysis of Vervet monkeys. An interview with Charlotte Canteloup, post-doc fellow in Prof. Erica Van de Waal's Real World Neuroscience unit.

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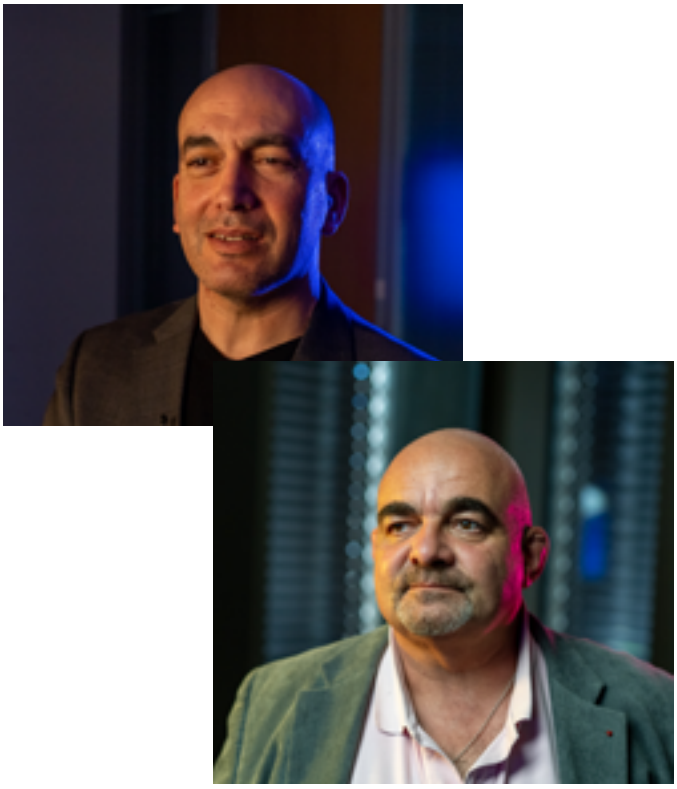
Edito

Prof. Micah Murray
Scientific & Academic Director

Prof. Olivier Lorentz
Executive Director



The Sense Innovation and Research Center was founded in 2021 by the University of Lausanne (UNIL), The Lausanne University Hospital (CHUV), and the University of Applied Sciences of Western Switzerland – Valais/Wallis (HES-SO Valais-Wallis).

This inter-institutional initiative aims to pool knowledge and resources in order to develop research, innovation and training projects in the field of sensory sciences around a concerted scientific strategy.

Why focus on the senses? Our senses are how we interact with our environment, one another, and ourselves throughout our lifespan and despite dysfunction or disease. While the central role of the brain in supporting perception, cognition, and behaviour is undisputed, we continue to have only a rudimentary comprehension of precisely how sensory processes undergird these functions and contribute to their dysfunction in disease.

The Sense is comprised of dedicated principal investigators and their teams, who know how to observe, to think, and to solve. The Sense's research units are in turn arranged along three unifying axes: Perception & Cognition, Action & Repair, and Devices & Data.

The Sense benefits not only from the guidance of its Scientific Advisory Board, but also from two additional external boards; one focusing on societal impact and the other on innovation and technology transfer. This constellation of local and international advisors not only helps to ensure the relevance of The Sense's activities, but also their practical implementation and application.

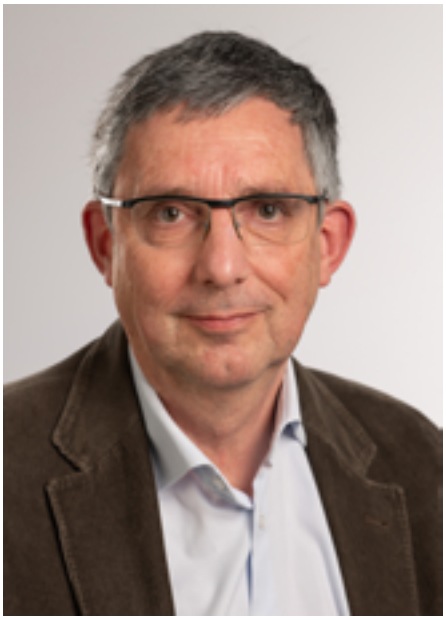
Our complementary backgrounds ensure The Sense can attain its ambitions. Prof. Murray has more than 25 years' experience in basic and clinical academic research in neuroscience as well as brain imaging/mapping methods development. This is paralleled by Prof. Lorentz's more than 30 years' experience in innovation and business development in academic and industrial contexts. Our collective experiences have impressed upon us the need for conjoining the local strengths in applied, basic, and clinical research and the opportunities in so doing for addressing societal needs.

We are profoundly grateful for the unwavering support of our founding institutions, for the tireless work of everyone affiliated to The Sense, and for the active engagement of our advisors. We look forward to continuing to share our discoveries with you and to show that The Sense is where innovation comes to life.

Edito

Prof. Reto Meuli

Chairman of the Council



- Could you describe your position and your mission within The Sense?

- I chair the Sense's council, whose mission is to ensure its strategic and scientific steering.

- You have been involved in several centres and initiatives in the Alemannic region. What makes The Sense unique?

- The Sense is a multidisciplinary and multi-institution organisation born from a collaboration between UNIL-FBM (Faculty of biology and medicine of the university of Lausanne) and HES-SO Valais-Wallis, which make it quite unique.

- What is your perception of The Sense with respect to your entire career?

- I perceive the Sense as one task among others that make up my academic and hospital activities. However, I am looking forward to seeing The Sense evolve in the coming years through many challenges related to research, innovation, and economic development.

Prof. Lara de Preux-Allet

Director HEdS / PI of the Inclusive Physical Rehabilitation Unit

News

First Edition of The Sense's Retreat

Last year, The Sense Innovation and Research Center organized its first edition of its retreat. Approximately seventy participants gathered for the occasion at the l'Hôtel Nendaz 4 Vallées & Spa. In addition to the representatives of our founding institutions – HES-SO Valais-Wallis, CHUV and UNIL – members of various advisory boards and other external partners actively partook in this event marked by collaboration, science and friendship....

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Rare Disease Day

February 28th shed light on Rare Disease Day, an international day dedicated to raising awareness about rare diseases. Rare diseases are only considered rare when they affect less than one person in 2,000 individually. In total, there are an incredibly large number of rare diseases, with approximately 7,000 rare pathologies identified. Due to their complexity and rarity, rare diseases can sometimes be challenging to diagnose and manage. To this end, MaRaVal has been providing expertise in this field in the French-speaking Valais region since 2017, and as of March 2023, they will also be available in the Upper Valais. In conjunction with Rare Disease Day, The Sense is partnering with MaRaVal to raise awareness about these rare diseases..

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Upcoming events

25.4.23

Open science: Open Access (OA) and Open Research Data (ORD)
Cécile Lebrand (CHUV)
Constance Delamadeleine (HES-SO)

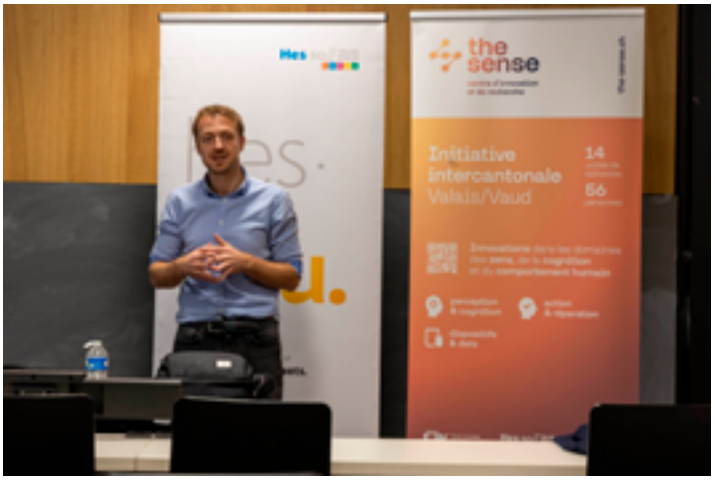
10.5.23

Understanding how events structure cognition and memory
Lucia Melloni (Max Pllanck Frankfurt)

14.6.23

The role of vision in perceptual space representation
Monica Gori (IIT)

News



Conference Health Institute / The Sense : "Train the brain to see again"

On Wednesday, January 18th, The Sense and the Health Institute co-organized a conference at Energypolis. This first event marks the beginning of a conference cycle for both The Sense and the Health Institute of HES-SO Valais-Wallis. Just over twenty people took part in this event. After a presentation of the innovation and research center, The Sense, by Professor Olivier Lorentz (Executive Director of Sense), visiting Professor Olivier Collignon presented the results of his research entitled “Brain Plasticity and Sensory Deprivation”, which is based primarily on the study of a panel of people who are blind from birth...

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Discover the Principal Investigators of The Sense Innovation and Research Center

Within The Sense, research is organized into three main areas:

- Perception & Cognition
- Action & Repair
- Devices & Data

Explore the 12 research units and the 16 affiliated Principal Investigators at The Sense. The presentation includes research activities, profiles of the Principal Investigators, partners, key publications, and research teams..

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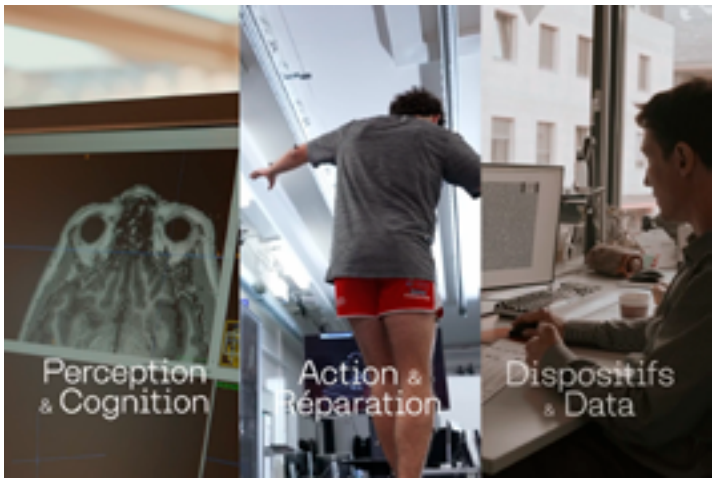


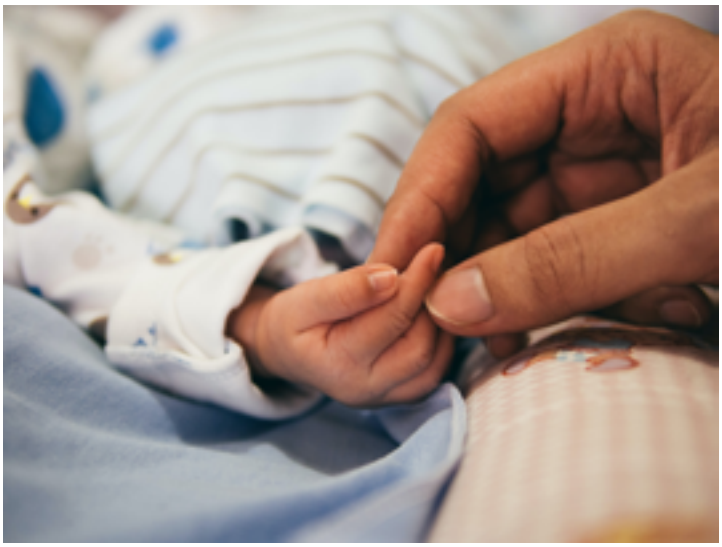
→ ALL OUR EVENTS

Inside The Sense

Neurosciences and education – Educational neurosciences are a research field that studies the way in which neuronal and cerebral processes influence learning and teaching. Let's focus on two research units working on the topic: Dr. Juliane Schneider's Neurodevelopment Unit and Prof. Paul Matusz's Real World Neuroscience Unit.

The Neurodevelopment Unit

The Sense's Neurodevelopment Unit is specialised in the monitoring of children with a risk of neurodevelopmental disorder from birth through school-age. Its projects address short- and long-term connections between very-early life events and perinatal environment, neurodevelopment during childhood, cognition in the broad sense of the term, neurosensory development, behavioural disorders and school/academic performance. Populations of newborns with a risk of cerebral lesions or brain maturation defects, in particular prematurely born children and newborns who have suffered from perinatal asphyxia, are studied longitudinally until they've reach school age. The purpose is to identify risk and protection factors for developing brains, such as the exposure to pain and stress in neonatology, nutritional strategies, developmental care, and environmental factors. In order to better assess maturation and the consequences of cerebral issues, the newborns and children are subjected to a multimodal neurological evaluation.



Juliane Schneider

Dr Juliane Schneider received her degree in medicine in 2003 and trained in the field of paediatrics. She later pursued further in-depth training in Neonatology, with a Foederatio Medicorum Helveticorum (FMH) title in 2012, later followed by Developmental Paediatrics (FMH title in 2020). Given her interest in Neonatal Neurology, she further pursued her education through a 2-year clinical research training fellowship in this field at the Toronto Hospital for Sick Children (Canada). Since her return in 2017, she has worked as a physician associate at the CHUV's Neonatology department, sharing her time between the Neonatal Intensive Care Unit and the Development Unit where follow-up care for high-risk children is provided.

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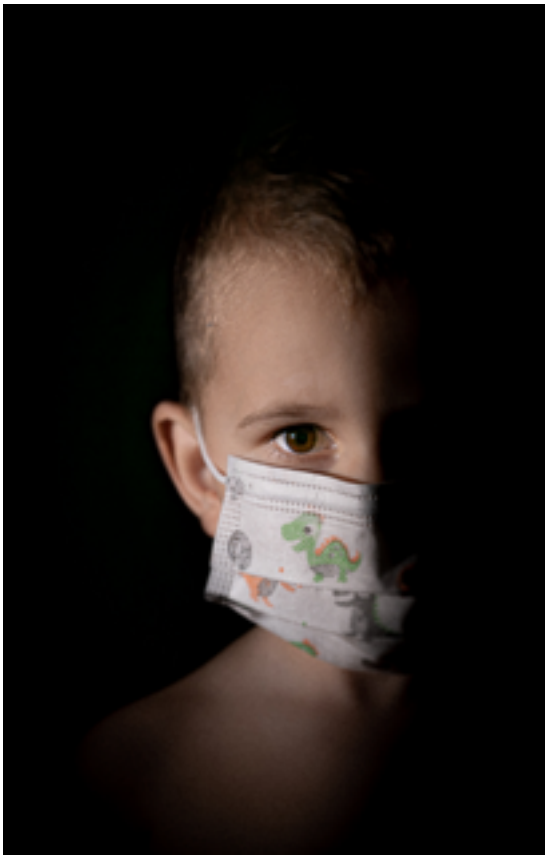
Current studies

Several groups of patients are currently in research protocols:

- The first study is devoted to the longitudinal monitoring of a cohort of severely premature children (<30 weeks of pregnancy) from birth until age 9. The assessment will consist in three serial MRIs between birth and the corrected age, as well as a cerebral MRI at the age of 9, and neurological and neuropsychological evaluations at the ages of 3 ½, 5, and 9.

- The second study (subject selection currently in progress) concerns the neurological future of children who've suffered from neonatal asphyxia. The neurological effects will be assessed in newborns prospectively selected through EEG, cerebral MRI and standardised neurological testing. Furthermore, 6-year-old children who have previously suffered from perinatal asphyxia will be re-examined through the same multimodal protocol (EEG, MRI and neuropsychological testing).

In addition, other research projects are currently under way, in particular concerning the Covid-19 pandemic and its impact on children's neurodevelopment. Collaborative projects within the Neonatology department are also exploring the impact of developmental care given in the department with regard to maternal mental health and the neurodevelopment of premature children.



Future developments and collaborations with The Sense

Having at our disposal a great quantity of data (clinical, imaging, and neurodevelopmental monitoring) collected over the past decade and covering populations with neurological risks of various types (prematurity, neonatal asphyxia), the research topics we can tackle are numerous.

Taking into account the current technological advances, specifically with respect to the processing of MRI imaging, EEG data analysis, and the handling of data on a larger scale, there is a need to create collaborations allowing for the exploration of new areas and which may bring answers to questions whose applicability would be acknowledged by the clinicians who care for these vulnerable populations. For this purpose, collaboration projects are being established between the Neurodevelopment Unit and other units within The Sense.

Inside The Sense

Neurosciences et éducation

The Real-world neuroscience Unit

The subject of Pr. Matusz's Unit could be summarized through a few questions: Whether we're working in an office or walking in the streets, what determines what we pay attention to? What are the objects that attract and retain our attention in particular? Is it preferable to study attention in the quietness of a laboratory or in an environment where it is actually operative? What about children's attention skills? Are they simply more distracted than us, the adults, until their attention reaches an "adult" level of maturity? Or perhaps does development offer certain forms of protection against distraction, with respect to adults?

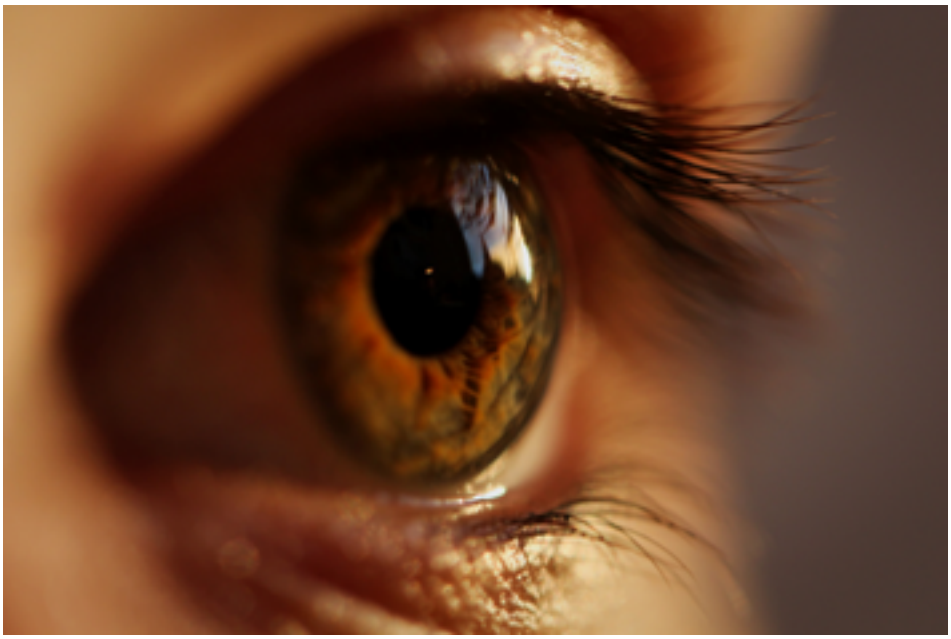
Lastly, when thinking of more direct benefits of attention skills, can we improve children's educational capacities, or adults' capacity to regain cognitive or sensory functions by training their attention in a targeted manner? These are some of the questions that the Group for Real-World Neuroscience (GROWN) of The Sense's Real World Neuroscience Unit has been exploring since it was instated in 2018.

Thus, in a nutshell, the GROWN seeks to understand how humans learn and recognize objects in daily situations, for example in a classroom or in the street, and the laboratory addresses this question by focusing on fundamental research areas such as:

1) the creation of more precise neurocognitive functions models, focusing on selective attention (a series of processes and cerebral mechanisms through which we preferentially process objects that correspond to current behavioural goals and ignore those which don't);

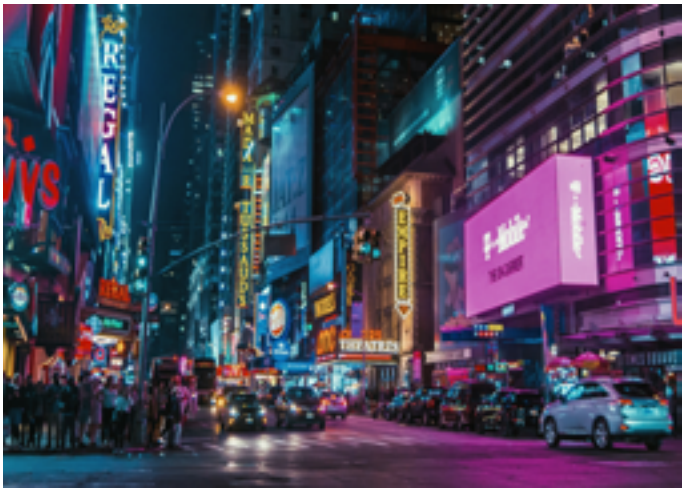
2) how do these processes and mechanisms develop with age, and how do they interact with the individual's experience, whether typical (experiences shared by all individuals) or atypical (for instance due to the abnormal development of one sense);

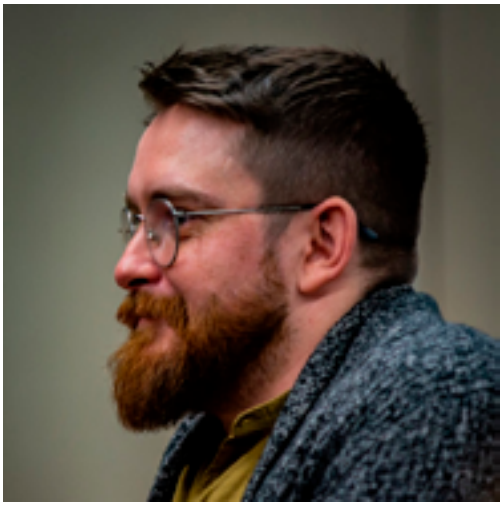
3) more applied work, on how to use this knowledge to develop approaches with higher effectiveness and efficiency in the detection of learning and sensory disorders as well as the related rehabilitative work, with children in particular. These goals are achieved thanks to an approach integrating rigorous yet naturalistic paradigms, behavioural methods, brain imaging (specifically EEG) and computational modelling. The GROWN also focuses the mobilisation of knowledge across various practices, in clinical and teaching activities, as well as in policies.



Up until now, the GROWN has yielded several interesting results in these three areas. In particular, it has clarified that in naturalistic environments, which entail a wealth of multisensory information, adults are more strongly influenced by distractors that stimulate several senses. This challenges the knowledge pertaining to attention control, according to which we control our attention at will, even when confronted with very distinct distractors.

Furthermore, a series of results has clarified how development affects attention control in naturalistic contexts containing abundant multisensory information. More specifically, it has been observed that children in the early stages of their school education, unlike adults, are protected from strong-type distractors that multisensory distractors are. The unit also demonstrated that in attention-testing tasks children obtain different results in comparison with adults. This could be due to the fact that children engage cerebral networks that are different than the adults', while also not optimally exploiting areas used by the brain when it has reached maturation.





Paul Matusz

Prof. Pawel Matusz completed his PhD in 2013 at the Birkbeck College of the University of London under the supervision of Prof. Martin Eimer. In his doctorate project, he used event-related brain potentials (ERPs) to show how, early in adult brains, object-based attentional selection is controlled by multisensory process types based on salience and directed at a target.

Since the end of his PhD and in collaboration with Gaia Scerif, of the University of Oxford, he has studied how dynamic interaction between multisensory processing, selective attention skills and experience shape object recognition in school-age children. In 2014, he started a 3-year post-doc training using methods analysing cutting-edge EEG signals to understand the brain and cognitive mechanisms that orchestrate perception, selective attention, and the learning of simple and complex multisensory objects throughout a person's life.

In 2016, he received his first competitive grant as leading researcher and has since received several other competitive subsidies both as leading researcher or as coresearcher to study the role of multisensory attention in learning processes as well as object recognition in healthy and atypical subjects.

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Inside The Sense

« Research studying attentively and broadly how cerebro-cognitive mechanisms activated by unisensory (visual, for instance) and more natural (multisensory) stimuli develop and are refined by a typical (school, for instance) and atypical (sensory, for instance) experience, will probably be the key, in the near future, for a better understanding and treatment of learning and developmental disorders. »

Prof. Paul Matusz

- What is currently your perspective on the field of neuroscience and education?

Paul Matusz: We live in an exciting era where we have learned enough about the workings of sensory systems with respect to multisensory processes, and where material and computational solutions are developed enough to start enriching our knowledge of the workings of neurocognitive processes in everyday situations, in adults and children alike. Selective attention processes have traditionally been studied based on purely visual or aural input. My group and I have shown that what we know about the processes that govern attention as well as the cerebral mechanisms supposed to sustain attention differs considerably between the typical visual contexts in laboratories, where they are studied, and everyday situations. The deployment of machine learning, using this data as a starting point, will probably offer new perspectives on the workings of attention in everyday situations.

- Which new perspectives will the use of machine learning allow for?

Paul Matusz: This knowledge would be particularly precious to understand cerebral/cognitive development and its reciprocal interactions with the learning of fundamental skills, such as reading or arithmetic, which later have cascading effects on other aspects of children's lives. Research studying attentively and broadly how cerebro-cognitive mechanisms activated by unisensory (visual, for instance) and more natural (multisensory) stimuli develop and are refined by a typical (school, for instance) and atypical (sensory, for instance) experience, will probably be the key, in the near future, for a better understanding and treatment of learning and developmental disorders.

Furthermore, sensory, cerebral and motor rehabilitation is probably the field that can most benefit from the approach that the GROWN has fine-tuned over the years. We expect our clinical study to provide evidence that we need new re-adaptation approaches. More specifically, we need approaches that treat the senses, cognition and motion as being part of a single system. This means that the knowledge of the brain and the senses is at the very core of re-adaptation. In addition, altered functions must be studied in contexts that are similar to those in which the same functions are used by the patients. The sensitivity of neuroimaging methods such as EEG and computer analysis such as machine learning will enable us to study these processes with great precision.

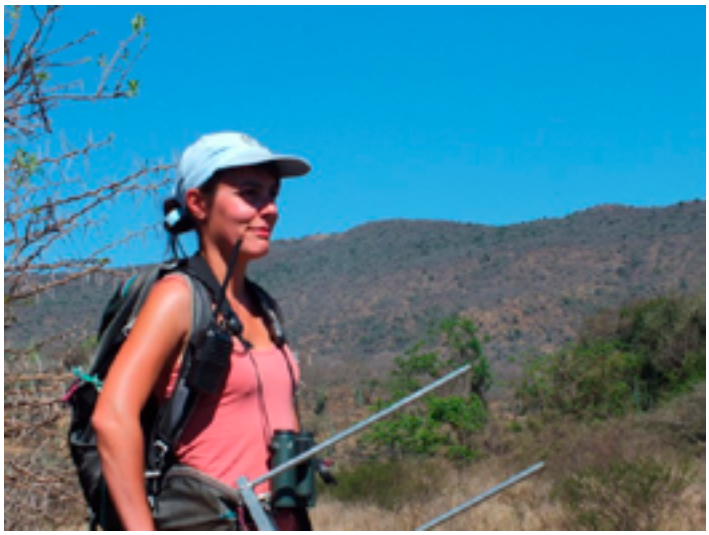
In order to continue capitalising on the results of the GROWN's projects, we need the support of medical data modelling experts in order to compensate for the scarcity of data (clinical, behavioural, neuroimaging and other) characteristic of our clinical populations, but we also need to develop and expand, with researchers and clinical experts who work on other disorders, such as Dr. Schneider. All this networking and expertise does exist within The Sense today and we are currently working on initiating exciting projects to capitalise on these unique advantages.

Interview

Charlotte Canteloup | post-doc

- Can you describe your research activities within The Sense?

Charlotte Canteloup: I have been working as a collaborator of Prof. Erica van de Waal for 5 years and I am currently completing my second post-doctoral fellowship in her team. My work has found its place within a greater debate in the scientific community regarding the origin of animal cultures and their skills and knowledge transmission modes. During my first post-doctoral project, I conducted experiments with Vervet monkeys in their natural environment in order to establish whether they were socially learning new foraging techniques by observing the other members of the group and, if so, what the vectors for social transmission were. I was able to show that Vervet monkeys did socially learn these new foraging techniques and that transmission was done from individuals with a higher social ranking towards lower-ranking individuals, which had not been evidenced before. My research work also showed that social learning is not important solely when acquiring new behaviour patterns, but also when maintaining preferred behaviour, which is scarcely investigated in the existing literature. During my second post-doctoral project, I sought to find out whether monkeys could learn from a non-living entity such as a robot. For this purpose, I conducted a pilot study which consisted in introducing a quadruped robot into one of the monkey groups that we study in our fieldwork in South Africa. After 6 days of the robot's presence, the dominant matrilineal lineage of the group was the one that had spent the greatest amount of time in the robot's vicinity and by far the most used to its presence! We recently conducted another experiment whose goal this time was to test whether the monkeys could learn from such a robot, trust its "knowledge" regarding unknown food. The data is being analysed and we will soon know more about this…



- Why did you choose to become a researcher?

Charlotte Canteloup: It was a choice that came about quite naturally. As a young student, I had a great passion for the animal kingdom and when I discovered ethology – the study of animal behaviour – I knew it was what I wanted to pursue! I was greatly drawn to fundamental research: contributing to the progression of knowledge and expanding insights into humankind while observing animals seemed like a dream job! From one internship to the next, I discovered the world of research and over time, through strength and perseverance, I made a place for myself since I just obtained my first permanent position as a research fellow at the Centre National de la Recherche Scientifique (national centre for scientific research) in France.

- Pouvez-vous nous décrire votre journée type de post-doc?

Charlotte Canteloup: What I love in this career is that there is actually no such thing as a typical day! As a researcher, I am free to organise my schedule as I wish, which is something very precious. When I'm in South Africa, it's a period when I collect data. I get up very early, usually around 4 am, to reach the field before the monkeys wake up. This allows me to set up the experimental devices that the monkeys discover when they come down from the trees in which they've spent the night. Once the experiment is completed, I go back to the field station to work on my computer and analyse the videos of the experiments. In general, I go to bed early (before 9 pm)! At night, we can hear the hyenas prowling around the house… Every day is different, as it is punctuated by ape-related anecdotes and animal encounters of all sorts: snakes, giraffes, warthogs… When I am back in Europe, I fall back into a more normal rhythm and my work mainly consists in the statistical analysis of the data, supervising of my students, drafting articles, participating in scientific conferences, numerous meetings with my colleagues, setting up new projects and securing research funds. In short, the life of a researcher is made up of routine, engagement, passion, surprises, unexpected events and discoveries!

« What I love in this career is that there is actually no such a thing as a typical day!»

Charlotte Canteloup

Sensory Awakening
Waterfall Illusion

[Find more illusions on Michael Bach's website]

What to do & observe

Fixate on the central cross during the motion and watch the cycle at least three times. Observe the motion aftereffect in the resting figure (the Buddha of Kamakura). [There is a more flashy version on the next page.] The "warping" caused by the motion aftereffect applies to anything you look at.

You may also try to cover one eye, adapt over ≈3 cycles and then test with the other eye (for this, you will need to stop the movie at the right point…). Well, how strong is your "interocular transfer"?

This is often explained in terms of "fatigue" of the class of neurons encoding one motion direction. It is, however, more accurate to interpret this in terms of adaptation or "gain control". These motion detectors are, for humans, not in the retina but in the brain (Bach & Hoffmann 2000).

Sources

Aristotle "De Somnis" (in Parva Naturalia, translated by Beare JI, 1931) chapter 2 (search for 'rivers'). [Interestingly, Aristotle did not describe the reverse motion, rather "…things really at rest are then seen moving".]

Lucretius TC (≈-50) De rerum natura, book 4

Addams R (1834) An account of a peculiar optical phenomenon seen after having looked at a moving body. London and Edinburgh Philosophical Magazine and Journal of Science 5:373–374

Mather, Verstraten & Anstis (1998) The motion aftereffect: a modern perspective. Cambridge, Mass: MIT Press

George Mather's MAE page (part of his nice motion site)

Kohn, A, and Movshon, JA (2003) Neuronal adaptation to visual motion in area MT of the macaque. Neuron 39: 681-691 [PDF]

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Bach M, Hoffmann MB (2000) Visual motion detection in man is governed by non-retinal mechanisms. Vision Res 40(18):2379–2385

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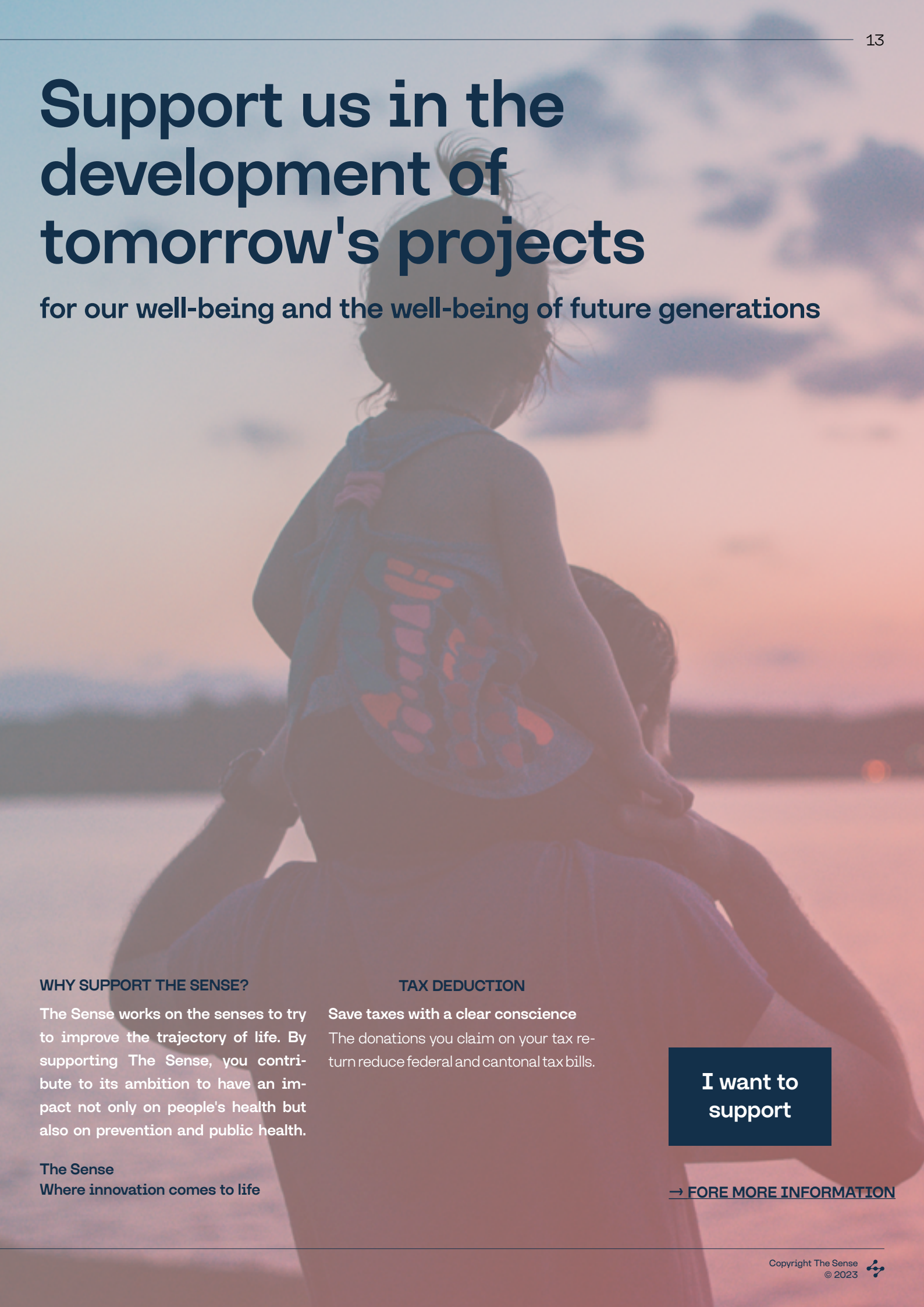
for our well-being and the well-being of future generations



WHY SUPPORT THE SENSE?

The Sense works on the senses to try to improve the trajectory of life. By supporting The Sense, you contribute to its ambition to have an impact not only on people's health but also on prevention and public health.

The Sense
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