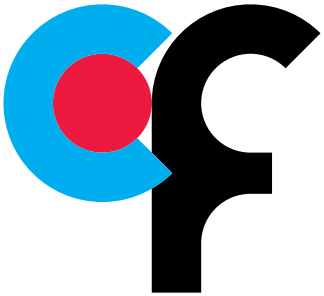
CNP

CHAMPALIMAUD NEUROSCIENCE PROGRAMME

2014

ANNUAL REPORT

Champalimaud Foundation



CNP

CHAMPALIMAUD NEUROSCIENCE PROGRAMME

2014

ANNUAL REPORT

OVERVIEW

THE CHAMPALIMAUD NEUROSCIENCE PROGRAMME

AIMS TO UNRAVEL THE NEURAL BASIS OF BEHAVIOR

CHAMPALIMAUD NEUROSCIENCE PROGRAMME

Since its establishment in 2007, the Champalimaud Neuroscience Programme (CNP) has grown from a handful of individuals into an expansive and dynamic research team of nearly 250 scientists. The programme's growth was not in numbers only, but also in the scope of its scientific and academic activities. These include the introduction of new fields of research represented by individual labs, new tools, techniques and the organisation of scientific meetings, courses and workshops. CNP researchers also regularly host international collaborators and travel to leading research institutions and conferences worldwide. At the same time, CNP researchers have been receiving significant support for their work from multiple funding agencies and institutions.

The success of the CNP stems not only from its high standard for scientific research, but also from its strong scientific culture. It focuses on encouraging collaboration and cooperation across individual research groups with the goal of advancing research as a whole while supporting the progress of individual scientists. As specified in the Mission Statement – "The aspiration of the CNP as an organisation is to help (its) scientists to reach their full creative potential and to promote collective achievements beyond those reachable by individual scientists or laboratory groups."

Following the vision of its Founder, in 2014 Champalimaud Foundation established a sister programme for CNP on the Biology of Systems and Metastasis (BSM). This newly founded programme will strive to gain deep understanding into how cancer cells interact with various host systems, including the vascular, immune, lymphatic and endocrine systems, and how these interactions change over time as the organism ages.

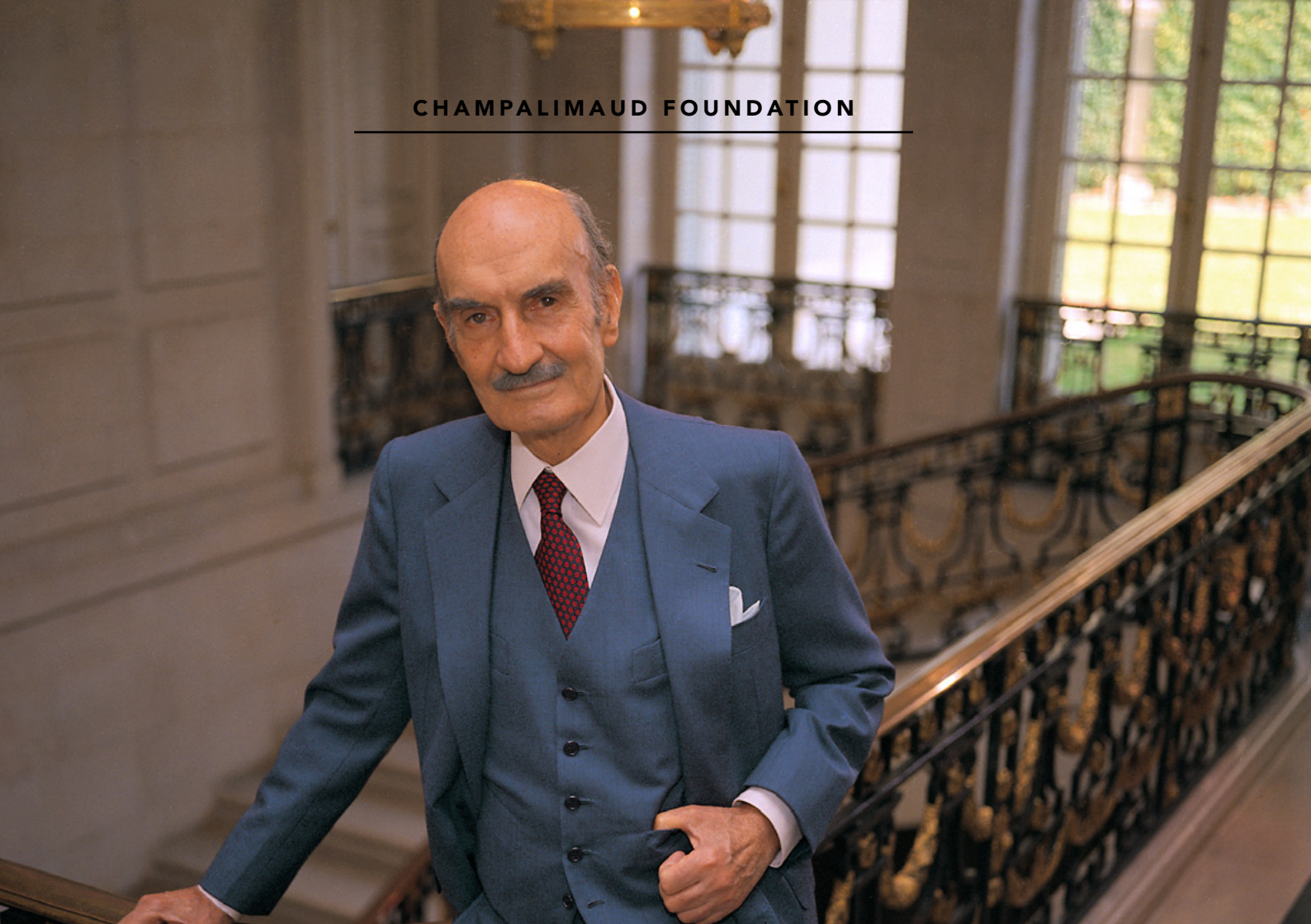
With this approach, BSM aims to create novel therapeutic strategies for the treatment of cancer. The two programmes together form Champalimaud Research, an overarching research programme with an integrated Direction Team that will include members of all research fields.

Champalimaud Research is based at the Champalimaud Centre for the Unknown, an institute where clinical and research activities run side by side. In this setting, supported by the scientific culture of the CNP, the two programmes are ideally situated to develop cross-field collaborations by sharing tools, approaches and ideas, thus facilitating progress within these two great realms of the Unknown.

ZACHARY MAINEN
Co-Director

RUI COSTA
Co-Director

CHAMPALIMAUD FOUNDATION



The Champalimaud Foundation, based in Lisbon, Portugal, was created at the bequest of the late Portuguese industrialist and entrepreneur, António de Sommer Champalimaud.

In 2005 it was officially incorporated as the Anna de Sommer Champalimaud and Dr. Carlos Montez Champalimaud Foundation, in honour of the benefactor's parents. As stipulated by António Champalimaud prior to his death, Leonor Beleza, former Portuguese Minister of Health, is the Foundation's President.

The Champalimaud Foundation supports individual researchers and research teams working at the cutting edge of biomedical science. It aims to stimulate novel theoretical and practical methodologies by utilising the experience of both research scientists and medical practitioners.

In particular, the Champalimaud Foundation focuses on the areas of neuroscience and oncology. The 17 groups comprising the Champalimaud Neuroscience Programme work to unravel the neural basis of behaviour. In oncology, the Foundation's medical teams work in the Champalimaud Clinical Centre to offer the highest possible level of disease management. The Foundation also supports an outreach programme designed to boost the fight against global blindness and vision disorders.

By engaging in these activities and research programmes, the Champalimaud Foundation has become a world-leader in both scientific innovation and management of human diseases. At the heart of its work is the notion of humanity as the ultimate beneficiary of breakthroughs in biomedical science and the Champalimaud Foundation strives to bring the fruits of its labours to those most in need - wherever they may be.

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SUSUMU TONEGAWA

CHAMPALIMAUD CENTRE FOR THE UNKNOWN

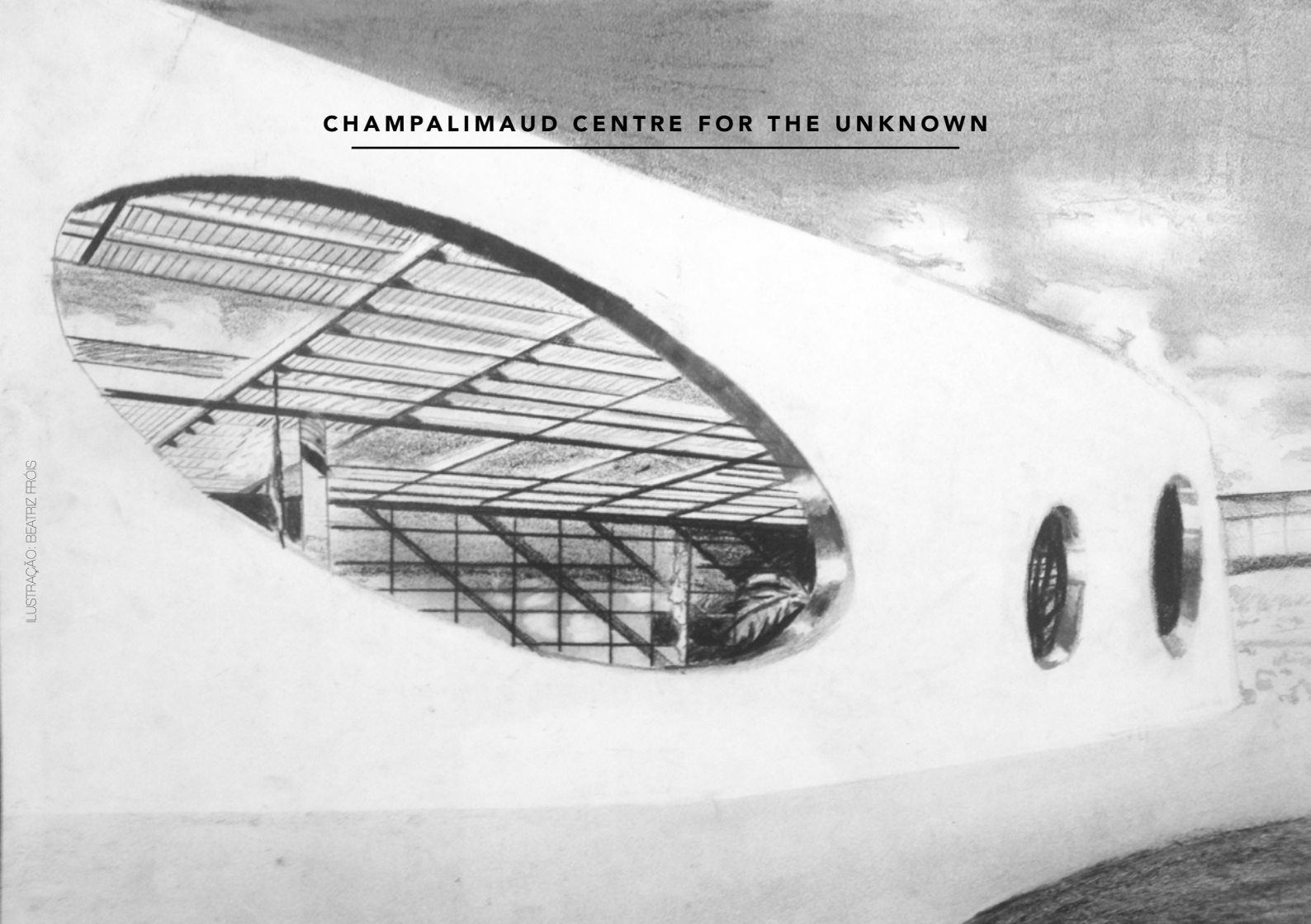


ILUSTRAÇÃO: BEATRIZ FRÓIS

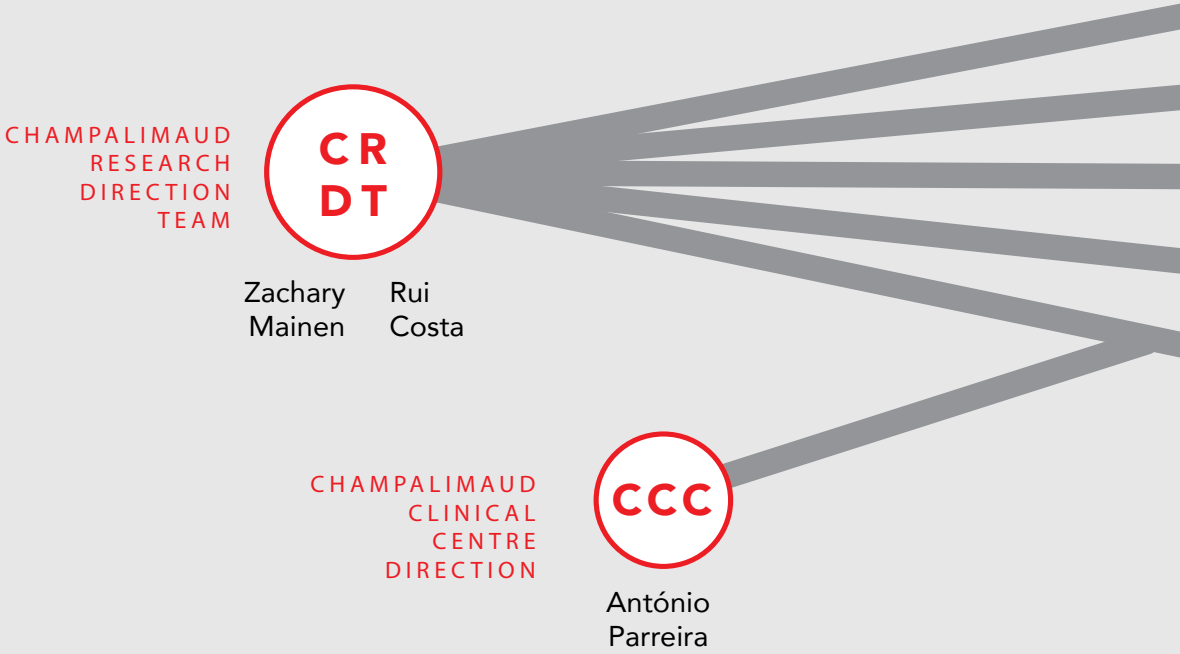
The Champalimaud Centre for the Unknown is a multidisciplinary centre for neuroscience research, translational cancer research and clinical practice. The Centre contains state-of-the-art facilities for basic and clinical research that hold cutting edge technological tools and equipment. In the short time since its inauguration in October of 2010, the Centre has hosted multiple international scientific events attended by world-renowned scientists. Furthermore, work at the Centre has received both national and international recognition, including multiple prestigious awards accepted by Champalimaud investigators.

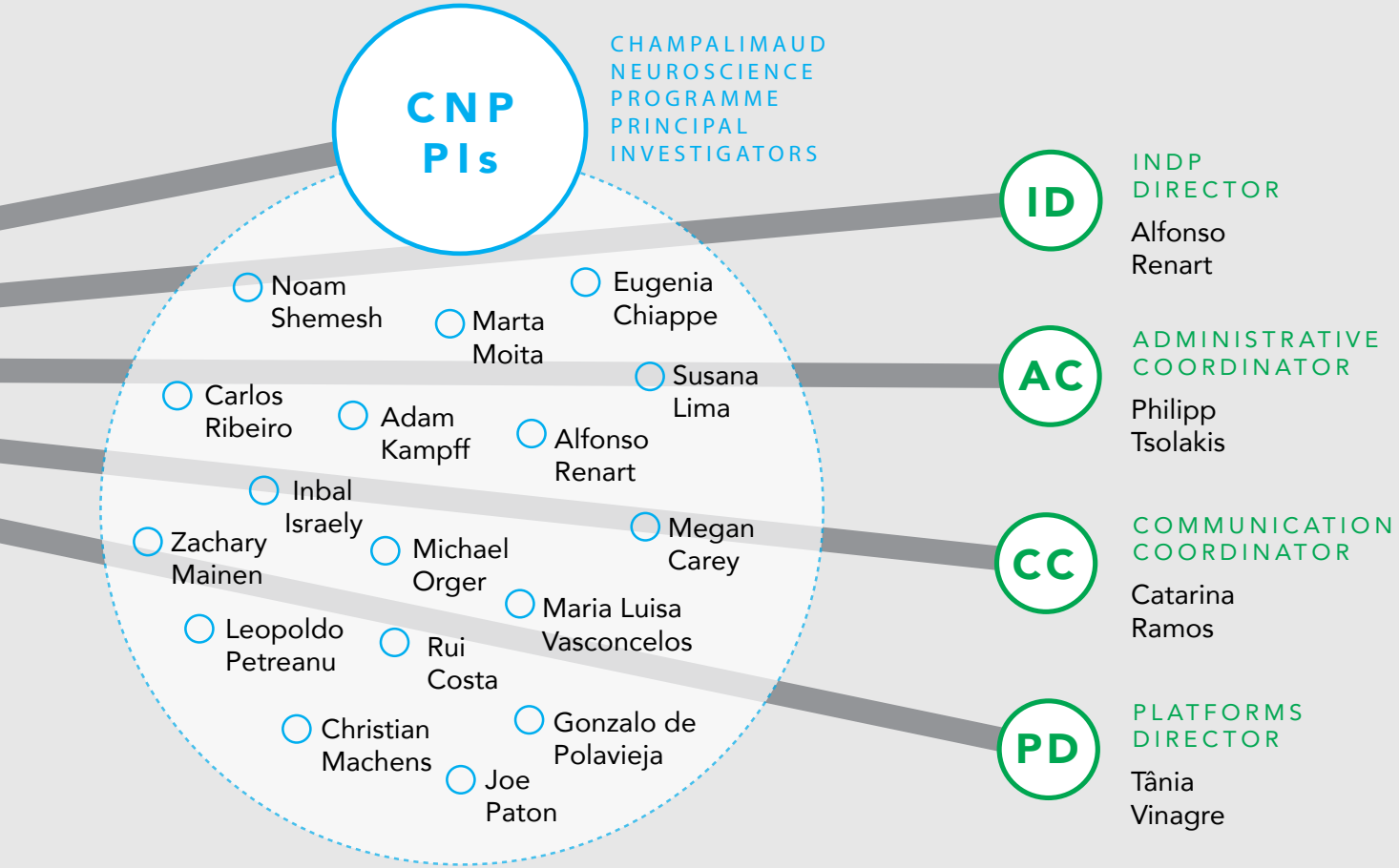
In addition to harbouring clinical and scientific excellence, the Centre is also designed to induce proximity and interaction between researchers, clinicians, patients, families and professionals. This singular mix of individuals at the Centre encourages the generation of new collaborations; collaborations that may be the key to the development of novel solutions to long-standing problems.

Beyond its practical value, the Centre also offers beauty and inspiration to the people of Lisbon, as free access is allowed to the landscaped areas of the building that run along the Tagus waterfront. This unique combination of stunning river views and exceptional architecture draws people of all ages to the Centre, where they are invited to breathe-in this graceful meeting of science and nature and join us in imagining the Unknown.

ZVI FUKS
Director

ORGANISATION OF THE CHAMPALIMAUD RESEARCH

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Leopoldo Petreanu
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Gonzalo de Polavieja
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ADMINISTRATIVE COORDINATOR
Philipp Tsolakis
CC
COMMUNICATION COORDINATOR
Catarina Ramos
PD
PLATFORMS DIRECTOR
Tânia Vinagre

SCIENTIFIC ADVISORY BOARD

The **Scientific Advisory Board (SAB)** of the CNP is composed of internationally recognised scientists who meet annually to review the progress of CNP researchers and programmes.

The SAB consists of regular members and additional external members who join on a yearly basis.

REGULAR SAB MEMBERS

THOMAS JESSELL
Columbia University, USA

J. ANTHONY MOVSHON
New York University, USA

MARTIN RAFF
University College London, UK

2014 SAB MEMBERS

LARRY ABBOTT
Columbia University, USA

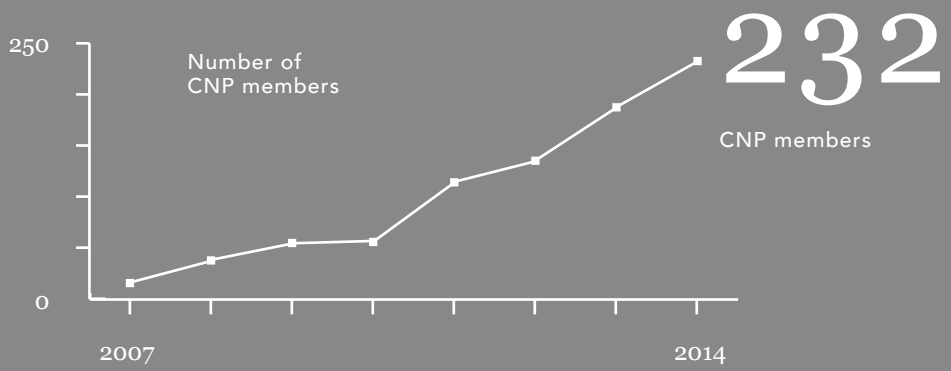
TOBIAS BONHOEFFER
Max Planck Institute of Neurobiology, Germany

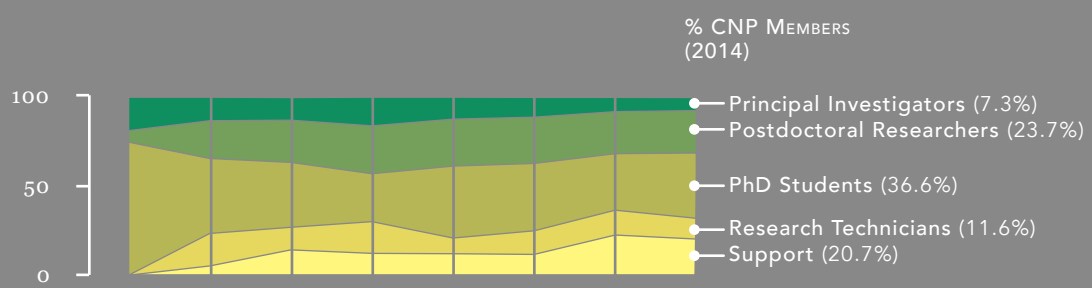

APPLY YOUR STICKER HERE

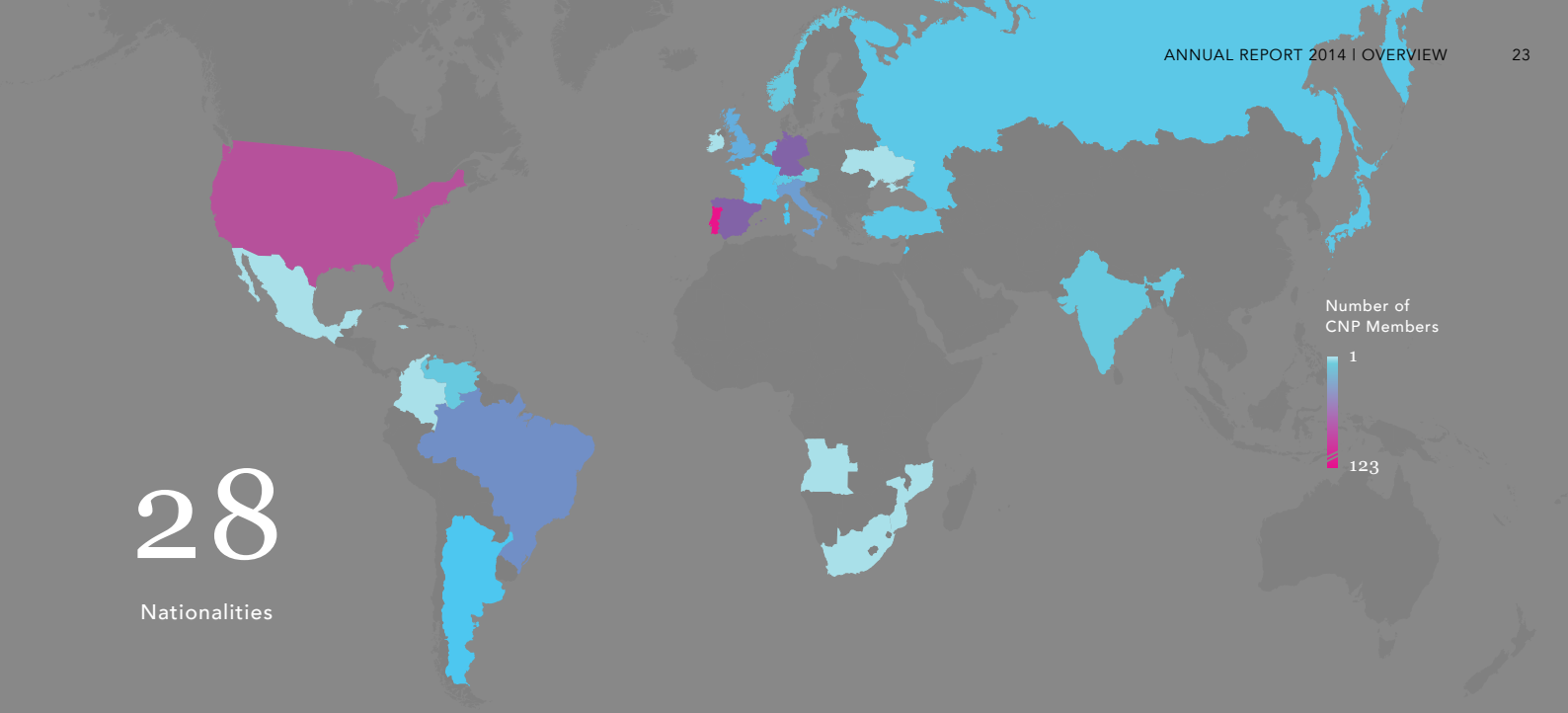
CNP Retreat 2014

GROWTH AND DIVERSITY

Since the beginning, in 2007, CNP members have always been a diverse group. This trend has persisted across the years, as CNP grew from a core of 16 individuals in 2007 to over 230 scientists in 2014.

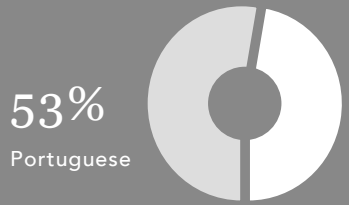






28

Nationalities



53%
Portuguese

47%
Other
Nationalities

NATIONALITIES
2014

51%
Male

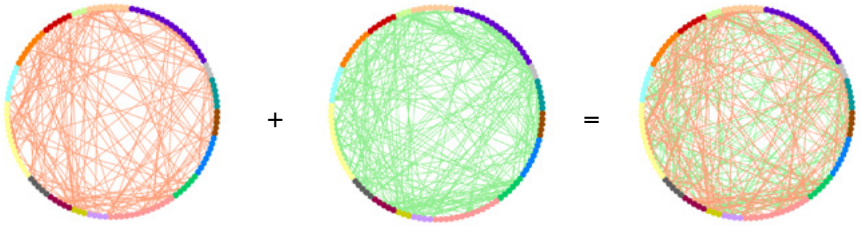
49%
Female

GENDER DISTRIBUTION
2014

GLIMPSING AT CNP CONNECTIVITY

In a survey conducted in preparation to the 2014 CNP retreat, CNP members had to answer 2 simple inquiries: (1) Name up to 10 CNP members you talk frequently with about work-related matters; (2) Name up to 10 CNP members you talk frequently with about non work-related matters.

Even though the results of this survey had a practical purpose during the retreat- to bring together CNP members that don't interact very often – they also provided a glimpse of how the CNP community is interconnected.



WORK CONNECTIONS

SOCIAL CONNECTIONS

OVERLAY

- Neural Circuits and Behavior Lab
- Sensorimotor Integration Lab
- Neurobiology of Action Lab
- Neuronal Structure and Function Lab
- Intelligent Systems Lab
- Neuroethology Lab
- Theoretical Neuroscience Lab
- Systems Neuroscience Lab
- Behavioral Neuroscience Lab
- Vision to Action Lab
- Learning Lab
- Cortical Circuits Lab
- Behavior and Metabolism Lab
- Innate Behavior Lab
- 1st Year INDP Students
- Support (Admin & Funding)

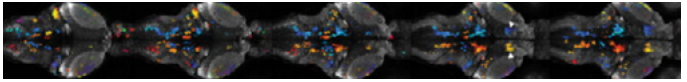
REPORT SNEAK PEEKS

RESEARCH

Two new Principal Investigators joined the Neuroscience Programme in 2014 - Gonzalo de Polavieja, head of the Collective Behaviour Lab and Noam Shemesh, head of the Neural Activity and Microstructure Lab. Each of these labs brings a new set of skills and approaches to the CNP, which include high level observations and analysis of group behaviour (Polavieja lab) and novel magnetic resonance imaging techniques that can provide novel views of brain structure, metabolism and function (Shemesh lab). *more on pages 50 and 146.*

PUBLICATIONS

Since its establishment in 2007 until Decembre 2014, CNP Principal Investigators have published more than 140 research articles in peer-reviewed journals. The studies described in these articles represent the scope of scientific interests within the CNP that include exact analysis of behaviour, measurement of complex network dynamics, constructing mathematical models and more. *more on page 188.*

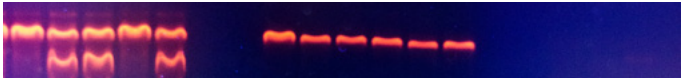


FUNDING & AWARDS

In 2014, the Champalimaud Neuroscience Programme was classified as Exceptional in the evaluation of Research and Development Units in Portugal by Fundação para a Ciência e a Tecnologia (FCT). This classification places the CNP among the top research units in Portugal and is associated with financial support for a period of several years. *more on page 170.*

SUPPORT

To facilitate the work of researchers, CNP Support has grown significantly since 2013 to include dozens of skilled technicians and administrative personnel. The range of services offered by CNP support is continuously expanding to accommodate the needs and research interests of all scientists and research groups. *more on page 199.*



REPORT SNEAK PEEKS

EVENTS

Organised in 2014, the One, two many Brains Workshop. explored what can two or many brains do that one cannot. It brought together international researchers who study the cognitive capacities of single brains with those who study social interactions. *more on page 244.*

CULTURE

As part of the events planned for the CNP annual retreat of 2014, a group of volunteers created Scientopia – a game that explores the scientific system. The game was played by the entire CNP community for 3 consecutive days during the retreat, leading to discussions among participants in and outside of the game. *more on page 276.*

OUTREACH

Roots of Curiosity was an art-science project designed by three CNP students and developed through a partnership between the Centro Cultural de Belém (CCB) and the Champalimaud Foundation. Over 2014, five pairs of artists and scientists were challenged to create an object that would be both artistic and scientific. Roots of Curiosity evolved into an art-science cycle where different formats were produced for different audiences. *more on page 232.*

EDUCATION

The CNP, together with the University of Bordeaux in France, was selected in 2014 to organise the CAJAL Advanced Neuroscience Training Programme, an initiative of the Federation of European Neuroscience Societies (FENS) in partnership with the International Brain Research Organization (IBRO). The CAJAL Advanced Neuroscience Training Programme offers intensive hands-on training in state-of-the-art neuroscience research, instructed by leading scientists in the field. *more on page 291.*

NEURAL CIRCUITS AND BEHAVIOUR

MEGAN CAREY

Principal Investigator

Champalimaud Foundation

Understanding how cellular and synaptic mechanisms interact within neural circuits to control behaviour is a fundamental goal of neuroscience. To achieve that goal, we need a thorough understanding of behaviour as well as a detailed knowledge of the underlying neural circuit. With this in mind, we focus our research on the cerebellum, a brain area that is critical for coordinated motor control and motor learning and whose circuitry is well characterised. Many of the neuron types in the cerebellum are molecularly identifiable, and existing technologies allow us to target transgenes to specific neuronal populations. By comparing specific aspects of behaviour and neural activity across mice in which we have targeted genetic perturbations to different cell types, we aim to determine links between cellular function, circuit activity and behaviour.

KEY PUBLICATIONS

Carey MR (2011) *Synaptic mechanisms of sensorimotor learning in the cerebellum.* Curr Opin Neurobiol 21:609-15.

Carey MR, Myoga MH, McDaniels KR, Marsicano G, Lutz B, Mackie K, Regehr WG (2011) *Presynaptic CB1 receptors regulate synaptic plasticity at cerebellar parallel fiber synapses.* J Neurophysiol 105:958-63.

Kim JC, Cook MN, Carey MR, Shen C, Regehr WG, Dymecki SM (2009). *Linking genetically defined neurons to behaviour through a broadly applicable silencing allele.* Neuron 63:305-315.

Carey MR, Regehr WG (2009) *Noradrenergic control of associative synaptic plasticity by selective modulation of instructive signals.* Neuron 62:112-122.

Carey MR, Medina JF, Lisberger SG (2005) *Instructive signals for motor learning from visual cortical area MT.* Nat Neurosci 8:813-819.

LAB MEMBERS

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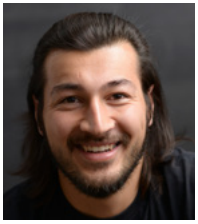
Postdoctoral
Researcher

Hugo Marques
Postdoctoral
Researcher



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FCT Fellow

Tatiana Silva
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Masters Student

Inês Prata
Research Technician

Tracy Pritchett
Research Technician


KleenGuard
B1, trial=1
230
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100

PROJECT

Funding

Grants – Howard Hughes Medical Institute (HHMI);

Fellowships – Fundação para a Ciência e Tecnologia (FCT);

Champalimaud Foundation.

Dissecting the role of endocannabinoids in eyeblink conditioning

Delayed eyeblink conditioning is a simple form of classical conditioning that depends critically on an intact cerebellum. Multiple synaptic plasticity mechanisms within the cerebellum have been identified and proposed as cellular substrates of learning for this behaviour. One class of molecules that appears to be important is endocannabinoids. Both cannabis users and cannabinoid receptor (CB1) knockout mice have been shown to exhibit impairments in delay eyelid conditioning. However, endocannabinoids are important for multiple plasticity mechanisms at many synapses, and it is not clear exactly where or how they act to modulate eyeblink conditioning. We are taking a genetic approach to this problem, by deleting CB1 receptors selectively from identified cell types within the brain. Through behavioural and electrophysiological experiments in these mice, we aim to constrain both the candidate sites and mechanisms of action for CB1 receptors in eyelid conditioning.

PROJECT

Funding

Grants – Howard Hughes Medical Institute (HHMI);

Fellowships – Fundação para a Ciência e Tecnologia (FCT);

Champalimaud Foundation.

Cerebellar contributions to coordinated locomotion in mice

Gait ataxia, or uncoordinated walking, is one of the most prominent symptoms of cerebellar damage, but the mechanisms through which the cerebellum contributes to coordinated locomotion are not well understood. Both ataxic mouse mutants and the sophisticated genetic tools available for manipulating neural circuits in mice have the potential to help shed light on this problem. However, analyses of mouse gait have typically lacked the kind of detail about the precision and timing of limb movements that would be required for a full analysis of coordination. We have built a custom video tracking system (LocoMouse) for measuring and analysing overground locomotion in freely walking mice. The LocoMouse system automatically detects the position of paws, snout, tail, and body centre in all three spatial dimensions with high spatiotemporal resolution. We have used this system to generate a comprehensive description of mouse gait parameters, including continuous paw, snout, and tail trajectories in time. We are applying the LocoMouse system to quantify the coordination deficits of ataxic mouse lines with cerebellar dysfunction, such as the Purkinje cell degeneration (pcd) mouse. These experiments are helping us to understand how the cerebellum contributes to specific elements of coordinated movement.

PROJECT

Funding

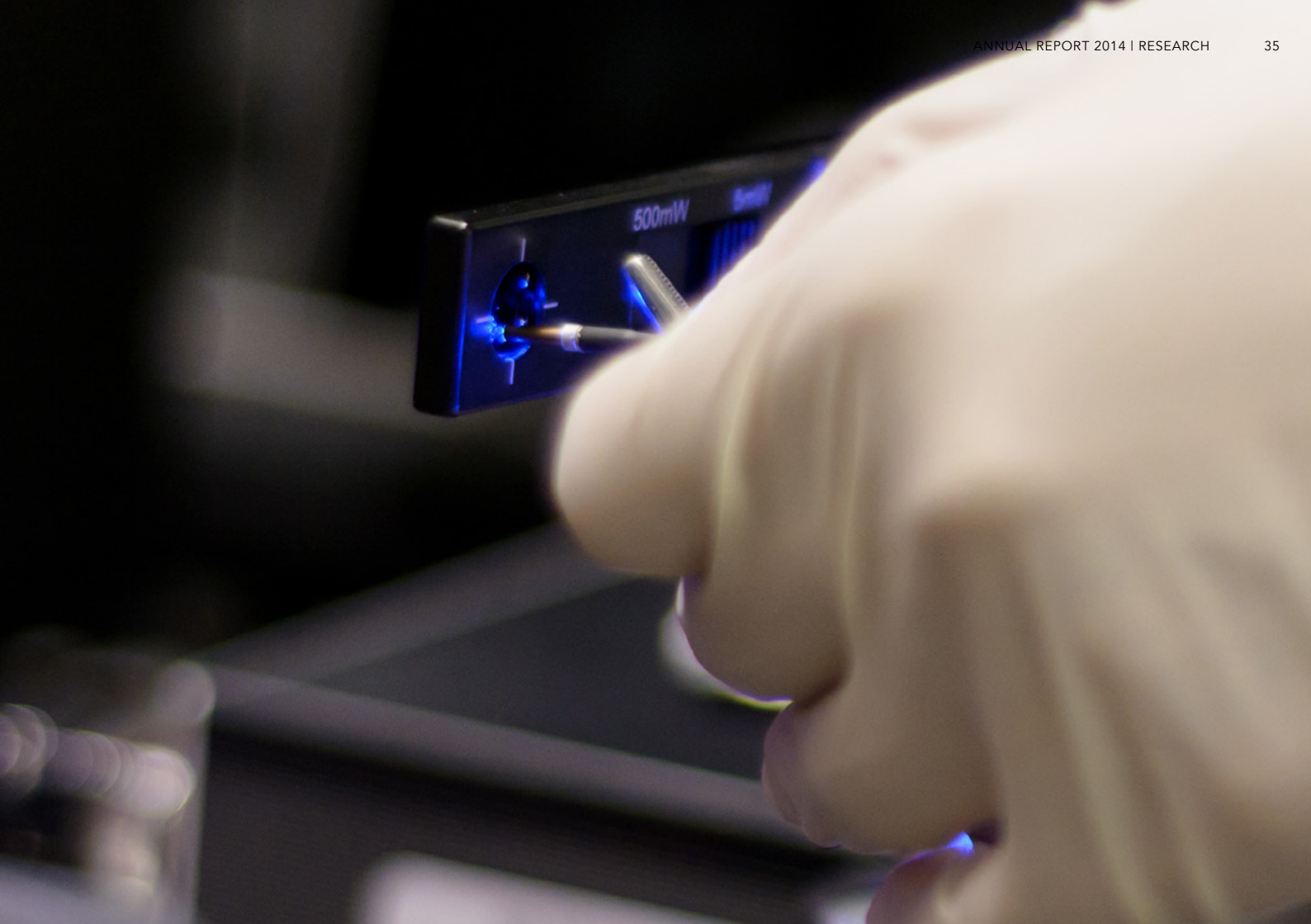
Grants – Howard Hughes Medical Institute (HHMI);

Fellowships – Fundação para a Ciência e Tecnologia (FCT);

Champalimaud Foundation.

Neural mechanisms of locomotor adaptation

Locomotor patterns are constantly adapted for changing environments but the neural mechanisms underlying this basic form of learning are not well understood. Locomotor adaptation has been studied in humans using a motorised split-belt treadmill in which the limbs on opposite sides of the body move at different speeds. Subjects adapt to split-belt walking over time by changing spatial and temporal gait parameters, which show negative after- effects in post- adaptation. This type of motor learning is thought to involve the cerebellum, as previous studies have indicated that patients with cerebellar lesions cannot adapt to the perturbation (Morton & Bastian, 2006). However, the circuit mechanisms within the cerebellum that support this adaptation are not known. We have built a split-belt treadmill for mice and are using it in combination with genetic and electrophysiological tools to investigate the neural basis of locomotor adaptation.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SENSORI_
MOTOR IN_
TEGRATION

EUGENIA CHIAPPE
Principal Investigator

Champalimaud Foundation

We are interested in the relationship between the dynamics of neural networks and animal behaviour. Our research focuses on the integrative processes by which the brain corresponds ongoing sensory signals with proceeding motor actions. Our goal is to identify patterns of neural activity representing computational principles occurring during sensorimotor tasks in small networks. In addition, we aim to describe the mechanisms by which these neural circuit computations emerge from the biophysical properties of neurons and synapses.

With only about 100,000 neurons, the brain of *Drosophila melanogaster* produces rather sophisticated orientation behaviours. The balance between brain numerical simplicity and behavioural complexity makes *Drosophila* an attractive experimental system to investigate how visually guided behaviours are implemented by small neural networks. We use novel methods that allow us to record the activity of neurons in a behaving fly during locomotion.

KEY PUBLICATIONS

Tuthill JC, Chiappe ME, Reiser MB (2011) *Neural correlates of illusory motion perception in Drosophila.*
Proc Natl Acad Sci USA 108 (23):9685-9690.

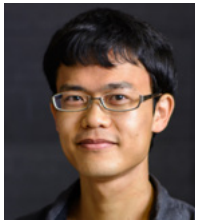
Chiappe ME, Seelig JD, Reiser MB, Jayaraman V (2010) *Walking Modulates Speed Sensitivity in Drosophila Motion Vision.*
Curr Biol 20 (16):1470-1475.

Seelig JD*, Chiappe ME*, Lott GK, Dutta A, Osborne JE, Reiser MB, Jayaraman V (2010) *Two-photon calcium imaging from head-fixed Drosophila during optomotor walking behaviour.*
Nat Methods 7 (7):535-534.

Tian L, Hires SA, Mao T, Huber D, Chiappe ME, Chalasani SH, Petreanu L, Akerboom J, McKinney SA, Schreiter ER, Bargmann CI, Jayaraman V, Svoboda K and Looger LL (2009) *Imaging neural activity in worms, flies and mice with improved GCaMP calcium indicators.* Nat Methods 6:875-881.

** Equal contribution*

LAB MEMBERS



Terufumi Fujiwara
Postdoctoral Researcher

Mert Erginkaya
INDP 2012 PhD Student, FCT Fellow

Tomás Cruz
Research Technician

Diana Amaro
Research Technician

James Bohnslav
Research Technician

PROJECT

Funding

Champalimaud Foundation.

Collaborators

GONÇALO LOPES, Champalimaud Neuroscience Programme, Portugal.

Development of behavioural paradigms to study sensorimotor integration

We are currently developing "freely moving" and "tethered" behavioural paradigms in virtual reality-like worlds designed to probe the computational capacities of the fly's brain during visually guided orientation behaviours. These shall form a platform for studying: a) how the fly uses its own movements and the generated visual motion cues to explore an environment, b) how her brain incorporates sensory signals to correct locomotion during orientation towards objects, and c) how do past experiences inform ongoing behaviour.

PROJECT

Funding

Grants – Fundação Bial, FP7 People (Marie Curie Career Integration Grant).

Identification of neurons and circuits involved in sensorimotor processing

The aim of this project is to understand how components in the circuit are linked and how the activity patterns of neurons arise from their synaptic connectivity. We identify neuronal components of a network using behavioural, physiological and anatomical methods. We then map connectivity among candidate neurons by combining chemical, optical and electrical techniques. Importantly, in the brain of the fruitfly it is possible to systematically identify the same class of neurons across different individuals. This allows investigating variability in synaptic connectivity and circuit function across different flies.

PROJECT

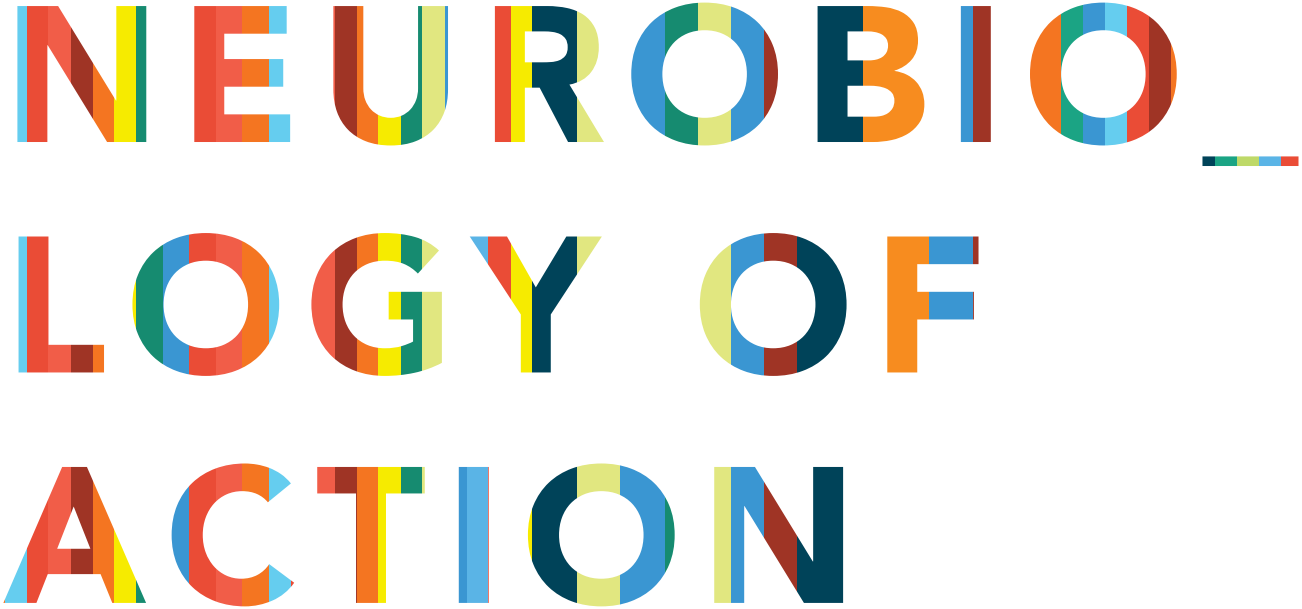
Funding

Grants – FP7 People (Marie Curie Career Integration Grant);

Champalimaud Foundation.

Probing neural processing during sensorimotor tasks

Simultaneously with head-fixed, tethered locomotion, we use electrophysiological and imaging techniques to monitor the activity dynamics of populations of genetically- or anatomically- defined groups of neurons. We apply quantitative analytical tools to correlate neural population activity with the behaviours described above, and to make predictions about the contribution of different groups of neurons to such behaviours. We examine the roles of different groups of neurons in the circuit by precise manipulations of their activity with genetic and optical techniques. These experiments are aimed at defining the functional logic of the circuitry in the context of a specific behaviour. By comparing different visual-motor tasks, our research attempts to identify common principles of visual-motor transformations.


NEUROBIO_
LOGY OF
ACTION

RUI COSTA
Principal Investigator

Champalimaud Foundation

To study actions is to study the way we do things, which is different than studying how we remember stimuli, or facts and events. Some actions are innate or prewired. Others are learned anew throughout life, likely through a process of trial and feedback. We currently focus on understanding the processes mediating the latter. Our overall goal is to understand how changes in molecular networks in the brain modify neural circuits to allow the generation of novel actions and their shaping by experience. To achieve this, we subdivided our experiments into different sub-goals to study action generation, action shaping and automatisation and action goals.

KEY PUBLICATIONS

Jin X, Tecuapetla F, Costa RM (2014). *Basal ganglia subcircuits distinctively encode the parsing and concatenation of action sequences.* Nat Neurosci. doi: 10.1038/nn.3632.

Cui G, Jun SB, Jin X, Pham MD, Vogel SS, Lovinger DM, Costa RM (2013) *Concurrent activation of striatal direct and indirect pathways during action initiation.* Nature. 494:238–242.

Koralek AC, Jin X, Long JD 2nd, Costa RM, Carmena JM. (2012) *Corticostriatal plasticity is necessary for learning intentional neuroprosthetic skills.* Nature. 483 (7389): 331-5.

Jin X, Costa RM (2010) *Start/stop signals emerge in nigrostriatal circuits during sequence learning.* Nature. 466 (7305):457-62.

Yin HH, Prasad-Mulcare S, Hilario MRF, Clouse E, Davis MI, Lovinger DM, Costa RM (2009) *Dynamic reorganisation of striatal circuits during the acquisition and consolidation of a skill.* Nat Neurosci. 12:3.

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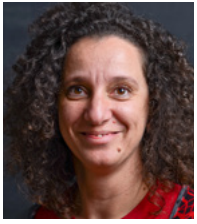

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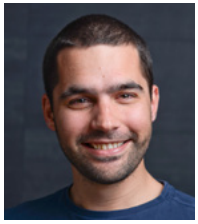

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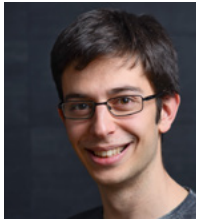
CLINICAL RESEARCH FELLOWS
(NEUROPSYCHIATRIC UNIT)



Bruno Afonso
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Patrícia Rachinas-Lopes
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COLABORATORS

PROJECT

Funding

Grants – European Research Council (ERC), ERA-NET;

Champalimaud Foundation.

Neural mechanisms of skill and sequence learning

Understanding how novel actions are learned and consolidated as sequences of movements and skills are the main aims of this project. We have uncovered neural activity in basal ganglial circuits that are related to the learning and execution of sequences of movements. We also used optogenetics to identify and manipulate the neurons mediating this activity.

PROJECT

Funding

Grants - Howard Hughes Medical Institute (HHMI);

Fellowships - Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation

Corticostriatal mechanisms underlying goal-directed actions and habits

Our goal is to understand the difference in the brain between intentional actions and habits or routines. We have uncovered that the dopamine transporter is a critical gate for habit formations; and also that different corticostriatal circuits dynamically interact during the shift between goal-directed actions and habits.

PROJECT

Funding
Grants – ERA-NET;
Champalimaud Foundation

Neural mechanisms underlying the generation of novel actions

This project aims to understand how new self-initiated actions are generated and how this ability is hampered in Parkinson´s disease. We have developed a new methodology to classify in an unbiased manner different behavioural and neural states.


COLLECTI_
VE BEHAV_
IOUR

GONZALO DE POLAVIEJA

Principal Investigator

Champalimaud Foundation

Many of our decisions, learning experiences and emotions take place under the influence of other people. What are the rules of this influence? How do these rules explain the emergence of group patterns? Our aim is to reach a quantitative understanding of some of these rules and to find the conditions under which group decisions improve or deteriorate.

We try to approach this problem using a variety of methodologies, including behaviour, neurobiology, molecular biology and mathematical modelling. We chose to implement this approach in zebrafish and humans. In zebrafish we can manipulate neuronal circuits and the underlying genetics and molecular biology and help design models that we can test and extend to human experiments.

KEY PUBLICATIONS

Pérez-Escudero A, Vicente-Page J, Hinz RC, Arganda S, de Polavieja GG. (2014) *idTracker: tracking individuals in a group by automatic identification of unmarked animals*. Nat. Methods 11 (7):743-8.

Arganda S, Pérez-Escudero A, de Polavieja GG. (2012) *A common rule for decision making in animal collectives across species*. Proc. Natl. Acad. Sci. U.S.A. 220 (9): 3651.

Rivera-Alba M, Vitaladevuni SN, Mishchenko Y, Lu Z, Takemura SY, Scheffer L, Meinertzhagen IA, Chklovskii DB, de Polavieja GG. (2011) *Wiring economy and volume exclusion determine neuronal placement in the Drosophila brain*. Curr. Biol. 21 (23): 2000-2005.

Pérez-Escudero A, de Polavieja GG. (2011) *Collective animal behaviour from Bayesian estimation and probability matching*. PLoS Comput. Biol. 7 (11): e1002282

Pérez-Escudero A, Rivera-Alba M, de Polavieja GG. (2009) *Structure of deviations from optimality in biological systems*. Proc. Natl. Acad. Sci. U.S.A. 106 (48): 20544–20549

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Francisco Romero
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Marta Iglesias
Research Technician


COLLECTIVE
BEHAVIOUR

PROJECT

Funding

Fellowships – Spanish MICIIN, Spanish JAE;

Champalimaud Foundation.

Theories of Decision-Making in Collectives

We are developing new theories of decision-making to better explain how animals, including humans, decide in groups.

PROJECT

Funding

Fellowships - Spanish Julian de la Cierva;

Champalimaud Foundation.

Tests in Zebrafish and Humans

We perform experiments in zebrafish and humans to test these theories and use data from other species to test their generality. We use these results to find out under which condition decisions and cooperation is best achieved and when it deteriorates. In zebrafish we can manipulate on molecular and neuronal circuit levels and in humans measure psychophysiological variables.

PROJECT

Funding

Fellowships - Leverhulme Trust, Spanish MICINN, Fundação para a Ciência e Tecnologia (FCT);

Champalimaud Foundation.

New Tools

We are developing new tools to obtain better datasets, including new tracking systems in 2D and 3D with no error propagation and a toolbox for analysis of group behaviour.

PROJECT

Funding

Fellowships – Fundação para a Ciência e Tecnologia (FCT);

Champalimaud Foundation.

Impact of Individuality, Confidence & Adversity

We are also interested in the impact of individuality on group behaviour and how the behaviour of the group impacts on individuality, at molecular, neuronal and behavioural levels. We are also testing the importance of some factors in these collective decisions, including the confidence on private and social information, implicit knowledge or how adverse the conditions are.

NEURON_AL STRUCT_URE AND FUNCTION

INBAL ISRAELY

Principal Investigator

Champalimaud Foundation

Diverse patterns of activity lead to the encoding of information, yet we know little about how such changes are physically stored at the level of individual neuronal connections. Can long lasting changes in efficacy lead to the physical organisation of synapses by directing growth or removal of specific inputs, and how do such changes affect connectivity within neural circuits? What types of changes take place following complex patterns of activity? We employ the precision of glutamate uncaging to stimulate individual synapses, and probe the related structural changes using 2-photon microscopy. Since abnormal spine shape is observed in several mental retardation disorders in humans, we are also studying neurons from these animal models in order to better understand the connection between structure and function. In summary, we combine molecular and genetic tools together with imaging and electrophysiological methodologies to determine how experience is physically stored in the brain, both in health and disease.

KEY PUBLICATIONS

Ramiro-Cortés, Y., Hobbiss, A.F., Israely I. (2014) *Synaptic competition in structural plasticity and cognitive function.* Philos Trans R Soc Lond B Biol Sci. 369(1633)p. 20130157.

Ramiro-Cortés Y, Israely I (2013) *Long lasting protein synthesis- and activity- dependent spine shrinkage and elimination after synaptic depression.* PloS One. 8(8):e71155. doi: 10.1371/journal.pone.0071155. eCollection 2013.

Govindarajan A*, Israely I*, Huang SY, Tonegawa S (2011) *The dendritic branch is the preferred integrative unit for protein synthesis-dependent LTP.* Neuron. 69 (1):132-146.

Arikkath J, Israely I, Tao Y, Mei L, Liu X, Reichardt LF (2008) *Erbin controls dendritic morphogenesis by regulating localisation of delta-catenin.* J Neurosci. 28 (28):7047-56.

Israely I, Costa RM, Xie CW, Silva AJ, Kosik K, and Liu X (2004) *Deletion of the neuron-specific protein delta-catenin leads to severe cognitive and synaptic dysfunction.* Curr Biol. 14 (18):1657-63.

** Equal contribution*

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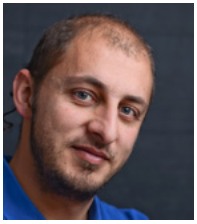

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XS5-6
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PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT), Fundação Bial;

Fellowships – Fundação para a Ciência e Tecnologia (FCT); Champalimaud Foundation (Portugal).

Dendritic synapse organisation via protein synthesis-dependent synaptic plasticity

Neural connectivity is shaped by activity. We aim to determine whether this also drives the physical organisation, or clustering, of inputs. This requires a mechanism by which to strengthen co-active spines and one by which to remove unwanted spines. We previously determined that indeed, protein synthesis dependent potentiation can facilitate cooperative interactions between neighbouring spines and supports the growth of multiple inputs. We are now investigating whether long lasting depression of selected inputs could contribute to an opposing process. Further, we are testing whether competition for newly made proteins is necessary for constraining the amount of plasticity that is expressed within a given dendrite, both during potentiation and depression. Using 2-photon imaging and glutamate uncaging, we examine the structural outcomes of bidirectional forms of activity at select spines and determine whether such changes can give rise to computational units within dendrites.

PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT), Bial Foundation.

Structural correlates of synaptic depression at dendritic spines

Synaptic potentiation leads to an enlargement of spine volume, however the long term structural correlates of synaptic depression are poorly understood. We aim to clarify this by determining the structural correlates of long lasting synaptic depression at dendritic spines. In particular, we are interested in exploring synaptic depression that depends on new protein synthesis, such as that mediated by metabotropic glutamate receptors (mGluRs). We develop novel paradigms for inducing such long lasting depression at single synapses, and follow this over the course of at least 4 hours. This allows us to probe whether cooperative and competitive interactions occur during synaptic depression. We also take advantage of animal models with a genetic deletion of the mGluR5 receptor, in order to probe how loss of this plasticity mechanism affects neuronal function. We hope to elucidate how activity through this receptor contributes to a neuron's ability to modify synaptic weights.

PROJECT

Funding

Fellowships – Fundação para a Ciência e a Tecnologia (FCT).

Collaborators

THOMAS MCHUGH, Riken Brain Science Institute, Japan.

Plasticity consequences of naturalistic spike trains at single synapses

Naturally occurring patterns of activity are complex in structure and have an irregular distribution of action potentials. It is unclear what plasticity results from such activity at individual inputs. Using *in vivo* derived activity patterns recorded from hippocampal area CA3 during a behavioural task, we aim to mimic the varied input patterns observed and apply them to individual spines in order to determine the structural and plasticity correlates of such activity. We will also investigate the resulting plasticity when multiple synapses within a dendritic branch are stimulated with such patterns, as the variable structure of pulses may give rise to different combinations of plasticity outcomes. We will then use this information to model neuronal information processing in order to understand the learning rules which govern synaptic weight changes *in vivo*.

PROJECT

Funding

Grants – TUBITAK (to Devrim Unay, Israely as collaborator).

Collaborators

DERVIM ÜNAY, Bahcesehir University Istanbul, Turkey.

Semi-automatic dendritic spine detection and analysis

Following stimulation of individual inputs, in addition to changes in the volume of the spine head, many other changes in spine structure have been observed, such as changes in spine neck length, outgrowth of the neck, non-spherical spine head shape alterations, etc. Such changes are difficult to quantify with existing methods, especially over multiple time points, and as such, we have been developing a semi-automated data analysis toolbox, developed in the MATLAB environment, for handling both the large data sets and the many variables to be analysed in such experiments. This tool utilises advances in medical image processing techniques to quickly register and identify spines within images, generating a multi-level region based segmentation that allows quantification of spine features. With this tool, we aim to achieve great precision and flexibility in the quantification of structural changes, as well as to significantly enhance the efficacy of data analysis.


INTELLIGE_
NT SYSTEMS

ADAM KAMPFF

Principal Investigator

Champalimaud Foundation

The goal of the Intelligent Systems Lab is to understand how a nervous system constructs a model of the world. How do brains learn about the statistics of their environment? How is this information encoded in networks and used to control intelligent behaviour? To answer these fundamental questions, two major technical advances must occur:

1. The development of virtual worlds in which the statistics and physics of the environment can be manipulated, providing experimental control over the model formed by an animal's nervous system.

2. The design and construction of novel devices for simultaneously recording from large populations of neurons throughout the brain of a behaving animal.

My research group strives to address both of these problems.

KEY PUBLICATIONS

Bianco IH, Kampff AR, Engert F (2011) *Prey capture behaviour evoked by simple visual stimuli in larval zebrafish.* Front Syst Neurosci. 5:101.

Naumann EA*, Kampff AR*, Prober DA, Schier AF, Engert F (2010) *Monitoring neural activity with bioluminescence during natural behaviour.* Nat Neurosci. 13 (4):513-20.

Orger M*, Kampff AR*, Severi K, Bollmann J, Engert F (2008) *Control of visually guided behaviour by distinct populations of spinal projection neurons.* Nat Neurosci. 11 (3):327-33.

Vislay-Meltzer RL, Kampff AR, Engert F (2006) *Spatiotemporal specificity of neuronal activity directs the modification of receptive fields in the developing retinotectal system.* Neuron. 50 (1):101-14.

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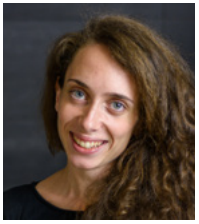

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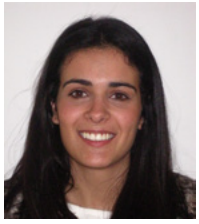

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PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT), FP7;

Fellowships – Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation.

Collaborators

JOE PATON, Champalimaud Neuroscience Programme.

Bonsai: a general purpose data stream processing framework for experimental neuroscience

Modern techniques in experimental neuroscience require the combination of many different technologies and software algorithms for data acquisition, analysis and instrument control. The development of such systems is often a time-consuming and challenging task. We present Bonsai, an open-source framework for rapidly prototyping and composing asynchronous data stream processing workflows, which is built on top of the Reactive Extensions for the .NET framework. The development of a Bonsai workflow revolves around two simple concepts: sources and combinators. Sources represent different data stream generation processes and devices, such as cameras, microphones and other data acquisition systems. Combinators provide ways to transform, filter, and otherwise manipulate these asynchronous data streams. We present the general architecture of Bonsai as well as the currently available packages for computer vision, audio and signal processing, data acquisition and instrument control. We also demonstrate several practical applications of the framework to the design of paradigms commonly used in experimental neuroscience.

PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT), FP7;

Fellowships – Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation.

Moving with motor cortex: A fine-scale analysis of rodent behaviour in unpredictable environments

Mammals excel at using statistical regularities to predict their environment, but the neural algorithms and representations underlying this ability to learn and use a predictive model are far from understood. In order to study this question in rodents, we designed a "modular" shuttling paradigm. In this task, rats are alternately rewarded at opposite ends of a U-maze and their crossings recorded using high-speed, high-resolution video. The walls and floor of the maze are composed of modular elements outfitted with programmable sensors and actuators, the rules of which specify the statistics of the environment. We performed a systematic exploration of behaviour in non-stationary environments and identified fine-scale metrics that will be paired with electrophysiology and lesion studies in cortical motor areas. Here we present the assay design and behavioural data collected during crossing of a series of obstacles, some of which change their configuration on a trial-by-trial basis. We show how rats quickly learn to navigate this environment and provide a detailed characterisation of behavioural responses to unpredictable reconfigurations.

PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT), Bial Foundation;

Fellowships – Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation.

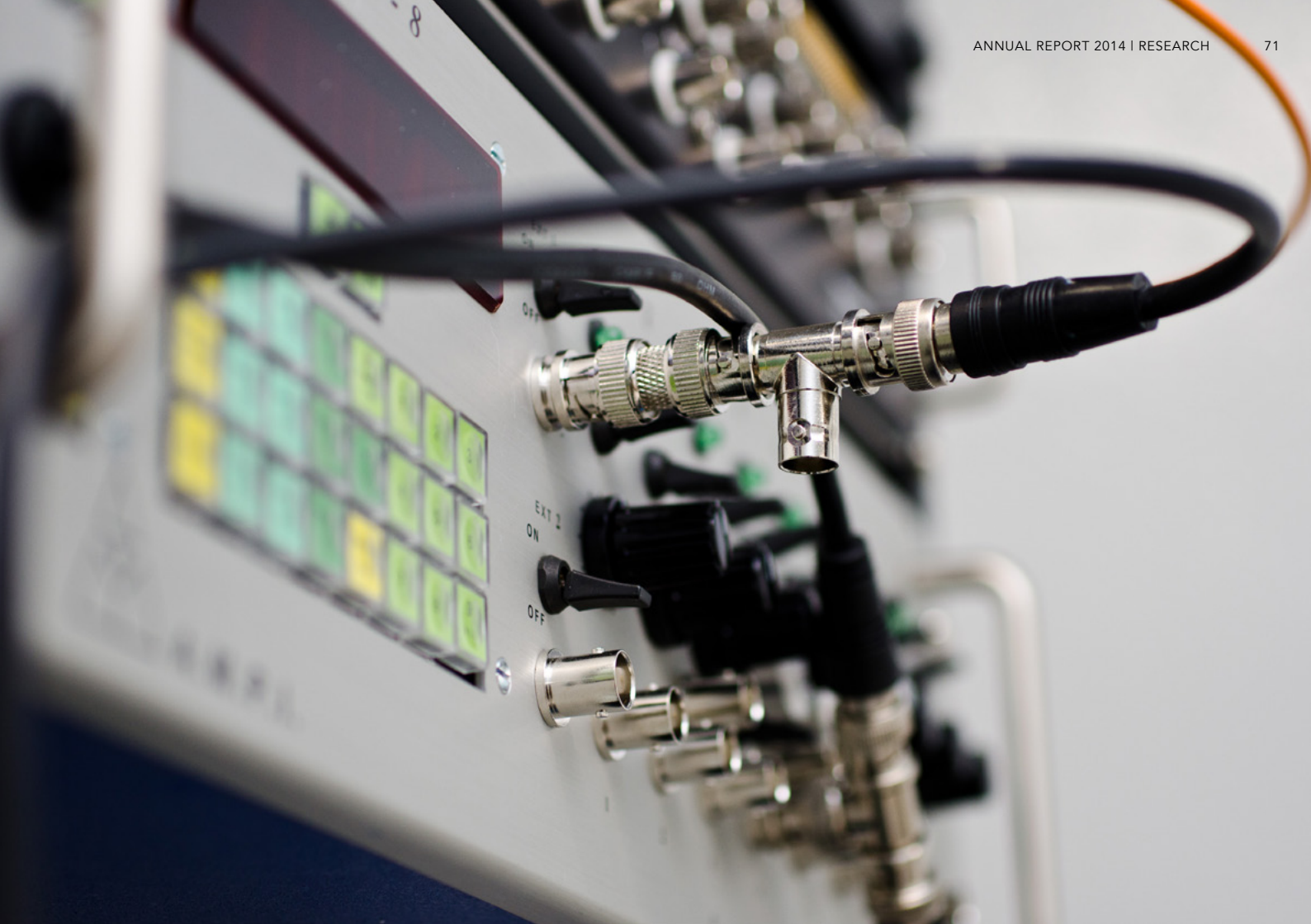
Collaborators

PEDRO BARQUINHA and ELVIRA FORTUNATO

(CENIMAT-Faculdade de Ciências e Tecnologia of Universidade Nova de Lisboa, Monte de Caparica, Portugal).

Nanostructuring strategies for improving the performance of neural electrodes

Extracellular electrical recording of neuronal activity is an important technique for understanding the function of nervous systems. However, major discrepancies have been observed when the signals detected with extracellular electrodes are compared to those recorded with other techniques (e.g. functional imaging). We hypothesized that the smooth, metallic surfaces commonly used for extracellular recording may be sub-optimal for detecting and isolating the activity of neurons in the vicinity of the probe. We are thus investigating novel electrode materials and structures, aiming to improve the electrode-tissue interface, optimise the SNR, and increase selectivity for dense signals. We used material processing techniques to make "nanostructural" changes to the microelectrode: a focused ion-beam (FIB) with 10 nm resolution and surface deposition of metallic oxides and conductive polymers. The effects of these structural and surface modifications were first verified by impedance and cyclic voltammetry measurements. We then evaluated the performance of the modified devices during acute recordings from mammalian brain structures.


EXT 2
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OFF


NEUROET_
HOLOGY

SUSANA LIMA

Principal Investigator

Champalimaud Foundation

The main goal of our laboratory is to gain mechanistic insights into the neuronal processes underlying behaviours fundamental for reproduction, in particular the choice of a suitable mate and how to initiate and terminate sexual behaviour. To do so, we use mice as model system and a combination of approaches that include physiological, anatomical and molecular tools to dissect the contribution of candidate brain areas to the emergence of these natural behaviours.

KEY PUBLICATIONS

Zinck, L and Lima SQ (2013) *Mate Choice in Mus musculus Is Relative and Dependent on the Estrous State.* PloS One. DOI: 10.1371/journal.pone.0066064

Lima SQ, Hromádka T, Znamenskiy P, Zador AM (2009) *PINP: A New Method of Tagging Neuronal Populations for Identification during In Vivo Electrophysiological Recording.* PloS One. 4 (7):e6099.

Lima SQ and Miesenbock G (2005) *Remote control of fly behaviour through genetically targeted photostimulation of neurons.* Cell. 121 (1):141-52.

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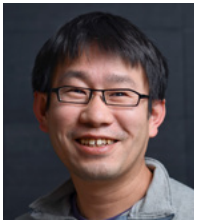

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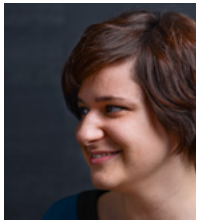

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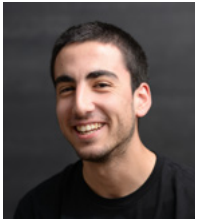

António Dias
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PROJECT

Funding

Fellowships – Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation.

Neuronal mechanisms for mate choice in mice

Mate choice is a complex decision that requires the integration of information from the environment, cues from potential mates, internal state and the chooser's preferences, (which are shaped by learning, early life experience and by the evolutionary history of its own species). During the last year we have developed an operant behavioural task to study mate choice in mice, where females are offered different social stimuli. In this task females can choose which conspecific to interact with and for how long they want this interaction to last. We are currently investigating the role of the ventral tegmental area in this process. In particular, we want to understand how the internal state modulates the female's behavioural choices and the activity of neurons within this brain region.

PROJECT

Funding

Fellowships – Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation.

Neuronal mechanisms underlying sex hormone- dependent switching of sexual receptivity

A female mouse that encounters a male will investigate him firstly, but eventually show different behaviours depending on the estrous cycle (i.e., having copulation or rejecting a male). Although previous studies have elucidated important brain areas which control female sexual behaviour, it is not known how

these brain areas respond during initial social interactions in which behavioural divergence is yet to happen. To address this issue, we performed electrophysiological experiments in freely behaving female mice. We targeted the ventrolateral part of the ventromedial hypothalamus (VMHvl). In our behavioural paradigm, a female mouse was allowed to interact freely with another mouse (either male or female), while neuronal activity was recorded. We found that the proportion of male-responsive neurons during the sexually receptive phase was higher than those during the other phases. These results suggest that the VMHvl has the capacity of changing its activity in a state and gender dependent manner, which might be important for performing appropriately depending on reproductive state.

PROJECT

Prolactin and its role on sexual behaviour

Funding

Fellowships – Fundação para a Ciência e a Tecnologia (FCT); Champalimaud Foundation.

Collaborators

NAOSHIGE UCHIDA, Harvard University

Prolactin, a hormone produced by the anterior pituitary, is involved in hundreds of biological processes. Several studies have shown that prolactin is released after ejaculation in men and rats. However, very little is known regarding the function of this surge. We have recently discovered that prolactin is also released in male mice after ejaculation. Hence, we are currently investigating which brain areas are capable of controlling prolactin release in vivo and developing methods to artificially control prolactin release in vivo and test its role directly on sexual behaviour.


THEORETIC_
AL NEURO_
SCIENCE

CHRISTIAN MACHENS

Principal Investigator

Champalimaud Foundation

How does the brain work? What are the kind of computations carried out by neural systems? We try to address these questions by analysing recordings of neural activity and constructing mathematical models of neural circuits. Our main goal is to link the activity within various brain areas to a computational theory of animal behaviour. We are currently developing methods to summarise the activity of neural populations in useful ways and to compare population activity across areas. In turn, we seek to relate the population activity to behavioural, computational, and mechanistic problems or constraints that organisms are facing. We work in close collaboration with several experimental labs, both within and outside of the CCU.

KEY PUBLICATIONS

Barrett D, Deneve S, Machens CK (2013) *Firing rate predictions in optimal balanced networks.* Advances in Neural Information Processing 26.

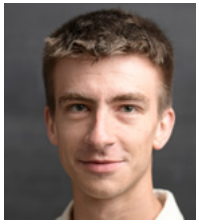
Boerlin M, Machens CK, Deneve S (2013) *Predictive Coding of Dynamical Variables in balanced spiking networks.* PLOS Comput. Biol. 9(11): e1003258.

Machens CK, Romo R, Brody CD (2010) *Functional, but not anatomical, separation of "what" and "when" in prefrontal cortex.* J. Neurosci. 30 (1), 350-360.

Machens CK, Gollisch T, Kolesnikova O, Herz AVM (2005) *Testing the efficiency of sensory coding with optimal stimulus ensembles.* Neuron 47 (3), 447-456.

Machens CK, Romo R, Brody CD (2005) *Flexible control of mutual inhibition: a neural model of two-interval discrimination.* Science 307, 1121-1124.

LAB MEMBERS



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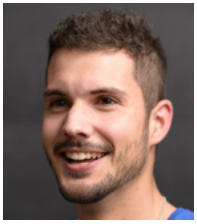

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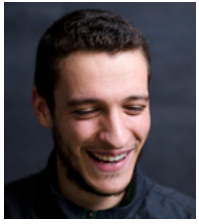

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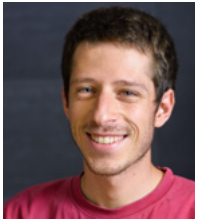

Pietro Vertechi
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PROJECT

Spiking network dynamics and tuning curves

Funding

Champalimaud Foundation, ENS Paris.

Collaborators

SOPHIE DENEVE, Ecole Normale Superieure, Paris, France.

Neural networks are capable of performing an incredible variety of difficult tasks, but how they manage to do this is poorly understood. We study how spiking neural networks can implement arbitrary linear dynamical systems - these encompass a huge variety of computations. We follow an approach in which the membrane potential of a neuron is reinterpreted as a 'prediction error' between a network's actual and desired output. Neurons only fire when this prediction error (membrane potential) exceeds a certain value. These assumptions naturally explain several mysterious properties of neural systems, such as the tight balance between excitation and inhibition, and irregular, asynchronous firing. We have made progress in understanding the main properties of the networks developed under the new assumption, and specifically, we have been able to show how the emergent properties of these networks relate to the tuning curves of neurons that are conventionally measured in electrophysiological experiments.

PROJECT

Robustness of networks to neuron death

Funding

Champalimaud Foundation, ENS Paris.

Collaborators

SOPHIE DENEVE, Ecole Normale Superieure, Paris, France.

The brain has an impressive ability to withstand neural damage. Diseases that kill neurons can go unnoticed for years, and acute conditions such as silent stroke have little impact on neural function. How does the brain compensate for such damage and what are the limits of this compensation?

We study the possibility that neural circuits optimally compensate for neuron death, thereby preserving their function as much as possible. We have shown that this compensation can explain changes in neural firing induced by neuron silencing across a variety of systems, including the primary visual cortex. We have been analysing how such optimal compensation can be implemented through the dynamics of networks with a tight balance of excitation and inhibition, without requiring synaptic plasticity. The limits of this compensatory mechanism are reached when excitation and inhibition become unbalanced, thereby demarcating a recovery boundary, where signal representation fails and where diseases may become symptomatic.

PROJECT

Analysis of neural population data

Higher brain areas receive inputs from many parts of the brain. The activity of neurons in these areas often reflects this mix of influences. As a result, neural responses are extremely complex and heterogeneous, even in animals performing simple tasks. In this project, we analyse neural population data and develop new data analysis tools to understand neural population recordings. We specifically follow probabilistic approaches, in which the goal is to characterise a (multi-variate) probability distribution that

Funding

Champalimaud Foundation, ENS Paris.

Collaborators

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(Cont.)

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ADAM KEPECS, Cold Spring Harbor Laboratory, USA;

CLAUDIA FEIERSTEIN, Champalimaud Neuroscience Programme, Portugal;

ZACHARY MAINEN, Champalimaud Neuroscience Programme, Portugal.

JOE PATON, Champalimaud Neuroscience Programme, Portugal.

represents the likelihood of finding a given neural response in a specific area. Our study of the population response in the PFC of monkeys and rodents during 2AFC tasks suggests that independent inputs like time, stimulus and reward are consistently represented in separate orthogonal subspaces.

PROJECT

Analysis of neural populations across areas

Funding

Fundação para a Ciência e Tecnologia (FCT)

Collaborators

BYRON YU, Carnegie Mellon University, USA;

ADAM KOHN, Albert Einstein College of Medicine, New York, USA.

Developments in neural recording technology are rapidly enabling the recording of populations of neurons in multiple brain areas simultaneously, as well as the identification of the types of neurons being recorded (e.g. excitatory vs inhibitory). As a result, there is a growing need for statistical methods to study the interaction among multiple, labeled populations of neurons. Rather than attempting to identify direct interactions between neurons, we propose to extract a smaller number of latent variables from each population and study how these latent variables interact. We have proposed a new method that allows for the extraction of these latent variables simultaneously, in a principled way. This model is

structured such that we can isolate internal dynamics from inter-population interactions on multiple time delays. We are now using the developed methods to study the interaction between visual areas V1 and V2 in macaque monkey.

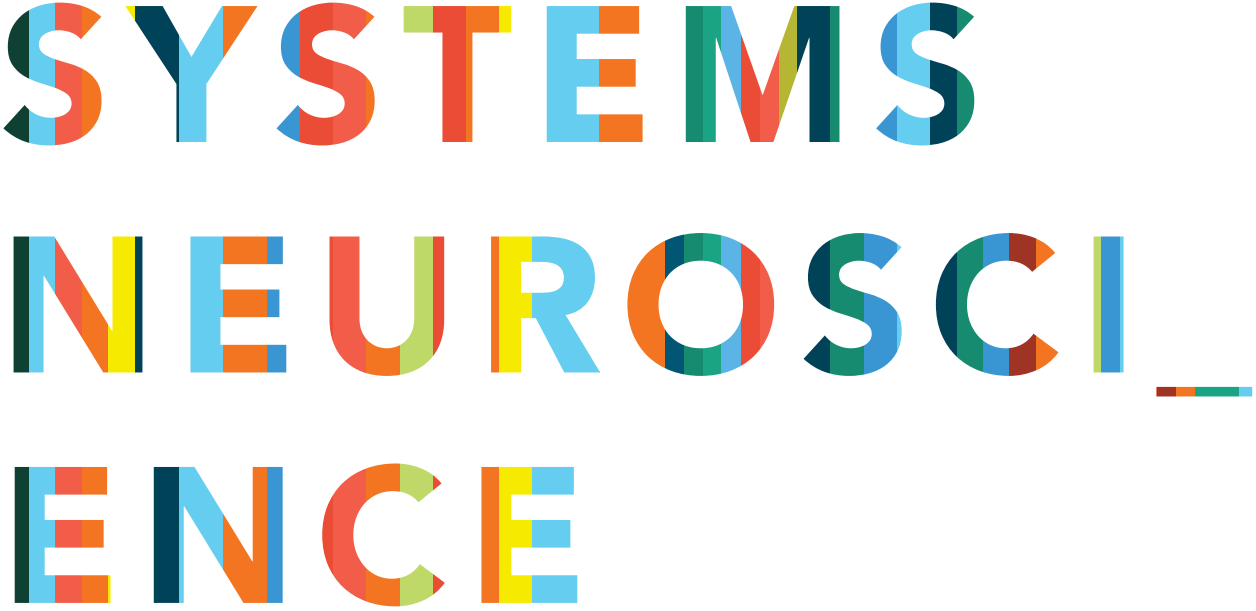
PROJECT

Funding

Champalimaud Foundation, ENS Paris.

Learning short-term memory

How does the brain select and store information over short time scales? We have started to study these problems on the level of neural networks, by combining new insights from the theory of balanced networks and efficient coding to short-term memory systems. We are interested in two specific systems: the oculomotor integrator, a simple short-term memory system that serves to stabilise eye position, and the prefrontal cortex, which is usually considered to be the brain's central working memory system. Our ultimate goal is to build a network that learns what it needs to remember and that reproduces the neural recording data typically observed in electrophysiological experiments of these systems.


SYSTEMS
NEUROSCI_
ENCE

ZACHARY MAINEN

Principal Investigator

Champalimaud Foundation

We are interested in understanding the principles underlying the complex adaptive behaviour of organisms. Starting with quantitative observations of animal behaviour, we aim to integrate quantitative cellular and systems level experimental analysis of underlying neural mechanisms with theoretical, ecological and evolutionary contexts. Rats and mice provide flexible animal models that allow us monitor and manipulate neural circuits using electrophysiological, optical and molecular techniques. We have made progress using highly-controlled studies of a simple learned odour-cued decision task and are extending our focus toward more complex behaviours. Recently we have begun to apply some of these ideas in studies on human decision-making and group behaviour. Current topics include: i) Perceptual decision-making; 2) The function of the serotonin system; 3) The role of uncertainty and confidence in brain function and behaviour; 4) The representation of space and action timing.

KEY PUBLICATIONS

Murakami M, Vicente MI, Costa GM, Mainen ZF. (2014). *Neural antecedents of self-initiated actions in secondary motor cortex.* Nat Neurosci. 17(11):1574-82.

Gomez-Marin A, Paton JJ, Kampff AR, Costa RM, Mainen ZF. (2014). *Big behavioral data: psychology, ethology and the foundations of neuroscience.* Nat Neurosci. 17(11):1455-62.

Miura K, Mainen ZF, Uchida N (2012) *Odour Representations in Olfactory Cortex: Distributed Rate Coding and Decorrelated Population Activity.* Neuron 74 (6):1087-1098.

Ranade SP, Mainen ZF (2009) *Transient firing of dorsal raphe neurons encodes diverse and specific sensory, motor, and reward events.* J Neurophysiol 102:3026-3037.

Kepecs A, Uchida N, Zariwala HA, Mainen ZF. (2008). *Neural correlates, computation and behavioral impact of decision confidence.* Nature. 455:227-31.

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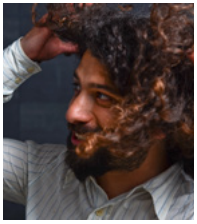

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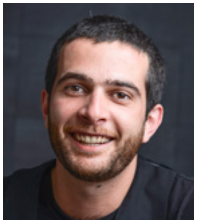

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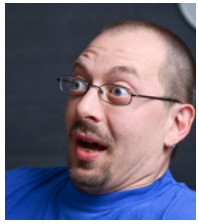

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Leo Madruga
Research Technician

Ana Nunes
Lab manager

PROJECT

Funding

Grants – European Research Council (ERC); European Comission

Fellowships- Helen Har Whitney Foundation (HHMF);

Collaborators

SUSANA VALENTE and SUSANA LIMA, Champalimaud Neuroscience Programme, Portugal

Optogenetic identification and control of serotonin neurons in behaving animals

Serotonin (5-HT) is a neurotransmitter implicated in a wide variety of physiological functions and psychopathologies. Little is known about the activity of 5-HT-releasing neurons in the brain. We developed and validated optogenetic methods that target 5-HT neurons, gaining access to record and perturb this system optically with high temporal and genetic specificity. We combined these tools with behavioural analysis and electrophysiological recordings toward understanding the role of 5-HT in adaptive behaviour. We aimed to stimulate, silence and monitor 5-HT function in the context of spontaneous behaviours, value-related decision-making, sensorimotor function and behavioural timing. We have recently found: (i) 5-HT activation suppresses responding to mechanosensory stimulation; (ii) 5-HT activation increases the willingness to wait for the delayed rewards but is not itself rewarding.

PROJECT

Funding

Grants – Human Frontiers Science Programme (HFSP).

Fellowships – Fundação para a Ciência e a Tecnologia (FCT).

Collaborators

ALEX POUGET, University of Geneva, Switzerland; MATTHIEU LUIS, Centre for Genomic Regulation (CRG), Barcelona, Spain.

Olfactory objects and decisions: from psychophysics to neural computation

Object recognition is a difficult problem solved by the nervous system and can be understood as a process of probabilistic inference. Complex stimuli are represented using a probabilistic population code. To link these ideas to specific neurophysiological and behavioural predictions we are using computational models. Our goal is to monitor and perturb object representations in the functioning, computing brain. By combining quantitative paradigms with large-scale neural ensemble recordings in the olfactory cortex, we can study how populations of neurons encode and process complex odour scenes, attempt to account for behavioural performance, and test the predictions of our theoretical models. We showed that olfactory sensory information was combined across modalities and within the same modality; genetic and optogenetic manipulations were consistent with Bayesian integration; olfactory decisions are described by a form of optimal integration in a sensory threshold odour detection task.

PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT);

Fellowships – Fundação para a Ciência e a Tecnologia (FCT); Champalimaud Foundation (CF).

Collaborators

HANAN SHTEINGART and YONATAN LOWENSTEIN, Hebrew University, Israel.

Action selection and action timing in the premotor cortex

Executing the right action at the right moment is important for adaptive behaviour. Thus, not only how we choose one action among multiple options but also how we determine the timing of actions are fundamental questions. Our goal is to understand what features of future actions are represented in the neuronal firing patterns in these areas, and how the interaction between neurons gives rise to the action selection and action timing processes. To achieve this goal, we are using multiple single-unit recording techniques in behaving rodents. By correlating the activity of neurons with the animal's behaviour, we are seeking to understand the internal representation of future actions in the motor cortex. Furthermore, by analysing the relationships of spiking activity amongst multiple neurons, we hope to gain insight into computations within the microcircuits in the motor cortex.

PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT);

Fellowships – Fundação para a Ciência e a Tecnologia (FCT); Champalimaud Foundation (CF).

Collaborators: ADAM KEPECS, Cold Spring Harbor Laboratory, USA.

Evaluating the reliability of knowledge: neural mechanisms of confidence estimation

Humans must often make decisions on the basis of imperfect evidence. We want to understand the neural basis for such judgments and how the brain computes confidence estimates about predictions, memories and judgments. We found that a population of neurons in the orbitofrontal cortex (OFC) tracks the confidence in decision outcomes. We tested whether confidence-related neural activity in the OFC is causally related to confidence judgments and addressed how the uncertainty about a stimulus in the course of decision-making is computed in olfactory sensory cortex. Currently we are establishing similar confidence-reporting tasks in humans to offer insights into the nature of the neural processes underlying confidence estimation. We show that waiting time is a sensitive implicit measure of decision confidence in human subjects; the calibration of confidence is affected by the feedback given on individual trials; explicit confidence reports impact both performance and waiting time.


BEHAVIOU_
RAL NEUR_
OSCIENCE

MARTA MOITA
Principal Investigator

Champalimaud Foundation

Living in a group has an adaptive value for a number of reasons. In the lab we focus on social interactions in different contexts, namely when individuals perceive a threat or when they are foraging for food. The neural mechanisms by which animals use social information to detect impending danger are largely unknown. We are studying how animals use defence behaviours of conspecifics as alarm cues. In addition, we study how the social context modulates defence behaviours. For example, we are studying how the presence of offspring affects defence behaviours displayed by mothers. We are also studying prosocial behaviour of rats using food foraging tasks. Here we would like to understand what drives an animal to coordinate with another or to perform an action that benefits another in the absence of self-benefit. To understand the mechanisms by which social interactions shape behaviour we use a combination of behavioural, pharmacological and optogenetic tools in rats and fruit flies.

KEY PUBLICATIONS

Pereira AG, Cruz A, Lima SQ, Moita MA (2012) *Silence resulting from the cessation of movement signals danger.* Curr Biol. 22 (16): r627-r628.

Guimarãis M, Gregório A, Cruz A, Guyon N, Moita MA (2011) *Time determines the neural circuit underlying associative fear learning.* Front Behav Neurosci. 5:89.

Antunes R, Moita MA (2010) *Discriminative auditory fear learning requires both tuned and nontuned auditory pathways to the amygdale.* J Neurosci 30 (29):9782-7.

Viana DS, Gordo I, Sucena E, Moita MA (2010) *Cognitive and motivational requirements for the emergence of cooperation in a rat social game.* PloS one 5 (1):e8483.

Moita MA, Rosis S, Zhou Y, LeDoux JE, Blair HT (2003) *Hippocampal place cells acquire location-specific responses to the conditioned stimulus during auditory fear conditioning.* Neuron 37 (3), 485-497.

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PROJECT

Funding

Grants – European Research Council (ERC);

Fellowships – Fundação para a Ciência e a Tecnologia (FCT)

Collaborators

SUSANA LIMA Champalimaud Neuroscience Programme, Portugal

Neural mechanisms of social transmission of fear in rats

This project aims at investigating the mechanisms underlying social transmission of fear in rats, i.e. how rats respond to the fear displayed by a conspecific. Having found that silence, resulting from the cessation of movement-evoked sound, is the cue that triggers observational freezing, we are currently searching for the neural mechanism of its detection. To this end, we are using optogenetic tools that allow temporally precise manipulation of neural activity. We are focusing on the amygdala, known to regulate defence behaviours and its auditory inputs. In addition, as observational freezing requires prior experience with shock, we are studying how prior self-experience with the aversive stimulus contributes to this process. We are testing the hypothesis that rats need to learn the association between freezing (the alarm cue) and shock (the aversive event) in order to display observational freezing.

PROJECT

Funding

Grants – European Research Council (ERC);

Fellowships – Fundação para a Ciência e a Tecnologia (FCT)

Collaborators

REGINA SULLIVAN (New York University, USA)

Social buffering of fear

Social interactions can decrease anxiety and fear in a variety of circumstances, a phenomenon known as social buffering, the neural mechanisms of which remain poorly understood. We use fear conditioning, during which an animal can learn to fear a neutral cue when it is paired with footshocks, to test the effect of social context on fear conditioned rats. We aim

to study the mechanisms by which social buffering might have a lasting impact in learned fear in adult male rats. In addition, we are studying the effects of social buffering in the context of maternal behaviour. We have focused on the regulation of maternal defence responses by the presence of their pups. We found that mothers freeze when exposed to a learned threat while alone, but do no freeze if exposed in the presence of their pups displaying instead various maternal and defence behaviours. We found this switch to depend on oxytocin in central amygdala.

PROJECT

Funding

Grants – European Research Council (ERC);

Fellowships – Fundação para a Ciência e a Tecnologia (FCT)

Collaborators:

MARIA LUÍSA VASCONCELOS, Champalimaud Neuroscience Programme, Portugal

Mechanism of propagation of defence responses in *Drosophila melanogaster*

To address the question of the neural mechanisms of social defence responses we propose to use a model system that is both amenable to the search for the neural mechanism of behaviour, while at the same time allowing the study of the behaviour of large groups of individuals. The fruit fly is the ideal model system, for its large collection of powerful genetic tools, a rapidly increasing number of approaches to study neural circuits and expanding set of behavioural paradigms, while at the same time its small size allows the study of the behaviour of large populations. Therefore, we are developing an assay to dissect social defence mechanisms in *Drosophila*. We have started by establishing a paradigm to study a well-known defence behaviour in flies, the escape flight/jump triggered by looming stimuli.

PROJECT

Funding

Grants – European Research Council (ERC);

Cooperation in social dilemmas in rats

We are interested in studying how rats make decisions when the outcome depends on their one choice and that of a partner. We are using the Stag Hunt game, a two-player, two-choice, coordination game, in which the best thing for a player to do is the same as the partner, and where one option entails a higher risk then the other. Having established a Stag Hunt game for rats using an automated double T-maze we found that rats learn to coordinate in order to maximise food rewards, that they are not just following the other rat and that they prefer the safer choice to the risky choice. Our goal is to understand the behaviour of dyads of freely choosing agents in a simultaneous choice version of this game. We are particularly interested in how the history of past-choice outcomes and the behaviour of the dyad at the time of decision predict the choices of both agents.

PROJECT

Prosocial behaviour in rats

To study prosociality in rats, a social species widely used in Neuroscience, we developed a two choice task, where prosocial behaviour did not yield a benefit or a cost to the actor. In this task, the actor could choose between one option that yielded food only to itself (selfish choice) and a second option that yielded food to itself and a recipient rat (pro-social choice). We used a double T-maze (one per rat), in which both animals were trained to poke in a nose-port in

order to gain access to food baited arms. However, during testing, only the actor's ports were active and these controlled the doors of both mazes. Through a series of experiments we found that rats showed a high proportion of prosocial choices. By manipulating reward delivery to the recipient and its ability to display a preference for the baited arm, we found that the display of food-seeking behaviour (poking in a nose-port) leading to the delivery of rewards is necessary to drive prosocial choice.

PROJECT

Neural mechanisms of trace auditory fear conditioning

Funding: Fellowships – Bial Foundation

Collaborators

ALFONSO RENART
Champalimaud Neuroscience Programme, Portugal

This project focuses on the role of different memory systems in trace auditory fear conditioning (tAFC). We have previously found that the length of the temporal gap separating the events (tone and shock) in this task determines the brain regions involved. When the interval is short, the amygdala and the medial prefrontal cortex (mPFC) are required for normal learning, but when the interval is long, in addition to these structures the hippocampus is recruited. We are studying how the memory of the tone is maintained in mPFC through the temporal gap. To this end, we are recording the activity of populations of simultaneously recorded neurons in medial prefrontal cortex during tAFC.

VISION TO ACTION

MICHAEL ORGER

Principal Investigator

Champalimaud Foundation

Our goal is to understand how the brain integrates sensory information and selects and executes appropriate actions. In particular, we aim to determine the organisation and function of neural circuits underlying visually guided behaviours. We use zebrafish as a model organism because it allows us to visualise and manipulate activity in neural circuits throughout a vertebrate brain. At just one week old, zebrafish can follow moving patterns, avoid predators and track and capture live prey. With their small, transparent head, the entire volume of the brain can be imaged non-invasively at single cell resolution. Our approach has three main themes:

1. Quantitative analysis of behaviour; 2. Whole brain imaging of neural activity dynamics; 3.Perturbation of identified neurons to reveal their role in sensorimotor processing.

In parallel, we are developing genetic tools that allow specific targeting and manipulation of identified cell types.

KEY PUBLICATIONS

Severi KE, Portugues R, Marques JC, O'Malley DM, Orger MB, Engert F (2014). *Neural control and modulation of swimming speed in the larval zebrafish.* Neuron, 83(3):692-707.

Portugues R*, Feierstein CE*, Engert F, Orger MB (2014). *Whole-brain activity maps reveal stereotyped, distributed networks for visuomotor behaviour.* Neuron. 81(6):1328-43.

Orger MB, Kampff AR, Severi KE, Bollmann JH, Engert F (2008). *Control of visual behaviour by distinct populations of spinal projection neurons.* Nat Neurosci. 11 (3): 327-333.

Muto A, Orger MB, Wehman A, Smear MC, Kay JN, Page-McCaw P, Gahtan E, Xiao T, Nevin LM, Gosse NJ, Staub W, Finger-Baier K, Baier H (2005). *Forward genetic analysis of visual behaviours in zebrafish.* PLoS Genet. 1 (5): e66.

Orger MB, Smear MC, Anstis SM, Baier H (2000). *Perception of Fourier and non-Fourier motion by larval zebrafish.* Nat Neurosci. 3 (11): 1128-1133 .

** Equal contribution*

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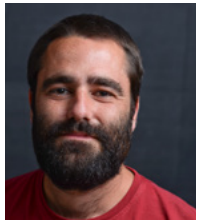

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PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT), Research and Development Grant;

Fellowships – Fundação para a Ciência e a Tecnologia (FCT).

Understanding the neural Mechanisms that Control Swimming Speed in Zebrafish Larvae

Animals often use distinct gaits to move at different speeds, and this requires the engagement of distinct neural circuits. Zebrafish larvae use different motor patterns, and recruit different spinal interneurons, during slow and fast swimming. Currently, it is not known how the brain computes desired speed or relays this information to the spinal cord. We have developed a system to perform high-speed online analysis of tail kinematics in freely swimming fish, while presenting visual stimuli. We find that zebrafish will adjust their swimming speed to track different moving patterns, and they do this by switching between two discrete motor patterns. We intend to discover the neural substrates responsible for this behaviour by imaging whole brain neural activity in restrained fish, during visually evoked swimming at different speeds in a closed-loop virtual reality environment. By thoroughly investigating the mechanisms of speed control in zebrafish larvae, from visual inputs to spinal circuits, we hope to uncover general principles of vertebrate locomotor control.

PROJECT

Funding

Grants – Marie Curie Career Integration Grant;

Fellowships — Fundação para a Ciência e a Tecnologia (FCT).

Collaborators

RUBEN PORTUGUES, Department of Molecular and Cellular Biology, Harvard University, USA;

FLORIAN ENGERT, Department of Molecular and Cellular Biology, Harvard University, USA.

Whole-brain imaging in behaving zebrafish

How neural circuits integrate sensory information to produce appropriate actions is a fundamental question in neuroscience. We aim to address this question by studying the circuits underlying reflexive response to visual motion patterns. Even these simple responses of the eyes and tail can involve coordinated activity in hundreds of neurons distributed in areas throughout the brain. We image the pattern of neural activity in the brains of transgenic fish, which express a genetically encoded calcium indicator in all of their neurons, while they track moving visual stimuli. Since these behaviours are very repeatable, we can systematically record responses from the whole brain with single cell resolution. Presentation of sets of stimuli which dissociate sensory and motor components of the behaviour allows us to determine what signals are carried by different populations. In this way we can comprehensively map the neural circuits underlying sensorimotor behaviours in a vertebrate brain.

PROJECT

Funding

Grants – Bial Foundation;

Fellowships – Swiss National Foundation (SNF).

Circuit mechanisms of visuospatial processing in the zebrafish brain

Complex visual behaviours, such as capturing moving prey or avoiding approaching predators, require animals to compute the location and salience of different objects moving in 3 dimensions. These computations depend on dynamic interactions between many interconnected visual areas in the brain. We use transgenic expression of

optogenetic tools with in vivo 2-photon functional imaging to reveal the cellular organisation of these circuits and the dynamics of visual processing in response to complex stimuli. We aim to:

1. Generate driver lines that target gene expression to specific cell types within the fish visual system; 2. Characterise visual response properties and functional topography within these populations; 3. Analyse the dynamics of population activity in the optic tectum and other visual areas, when the fish is presented with competing visual targets.

Using optogenetics and laser ablations we will interfere with defined circuit components, to determine the link between circuit computations and behaviour.

PROJECT

The structure of zebrafish behaviour

We have developed a high-speed video tracking system for zebrafish larvae. Our software allows real-time extraction of complete tail and eye kinematics in multiple freely swimming fish, and can use this information for closed loop control of the presentation of visual and other stimuli. We are using this system to systematically characterise the swimming behaviour of zebrafish under a broad set of conditions. An important aim is to produce a general, quantitative framework to describe the fish's locomotor behaviour. We have applied unsupervised machine learning methods to identify distinct categories of swimming behaviour. Using a data set of millions of bouts of swimming, acquired under different behavioural conditions, we have identified a fundamental set of distinct categories

of swim. We have then explored how the fish adjusts its choice of swim and modulates the kinematic parameters within these categories to respond to different stimuli.

PROJECT

Funding

Fellowships – Austrian Academy of Sciences (AAS), Fundação para a Ciência e a Tecnologia (FCT).

How zebrafish respond to changes in illumination

Larval zebrafish show several innate responses to spatial and temporal changes in illumination, from rapid orientation and taxis to sustained modulation of locomotor activity. However, little is known about the underlying neural circuits and how neuromodulators act on them to alter locomotor behaviour. Using high-speed video tracking in a custom-built arena we quantitatively assess the fishes' choice of swimming behaviour in response to visual stimuli such as whole field luminance changes and local light and dark patches. We aim to determine the neural activity evoked by the same stimuli using *in vivo* calcium imaging of transgenic fish expressing genetically encoded calcium indicators. In parallel, we are building a library of short promoter sequences that target expression to distinct neuronal types, including different neuromodulator populations, with the aim of developing a comprehensive set of transgenic driver lines. These can be combined with different reporter lines to: 1. Optogenetically activate or silence these populations; 2. Record activity specifically from these populations; 3. Trace their projections in the brain.


LEARNING

JOE PATON

Principal Investigator

Champalimaud Foundation

Learning to adaptively respond to cues in the environment that predict behaviourally relevant events is critical for survival. However, animals are exposed to a myriad of sensory stimuli and learning the predictive value of cues is non-trivial. How do animals figure out which cues are predictive, and of what, and once they do, how do they stamp in this information? This is called the credit assignment problem. Conceiving of this problem as statistical inference in the time domain offers a parsimonious account of animals' learning abilities. That is, when cues occur relative to meaningful events is what determines whether they warrant learning about. However, we still do not understand how the brain might keep track of time and how this information is used to adapt behaviour. We aim to reveal neural mechanisms for time and adaptive behaviour by observing and manipulating neurophysiology in behaving rodents performing tasks where they estimate intervals or make flexible, value-based decisions.

KEY PUBLICATIONS

Gomez-Marin A., Paton J.J., Kampff A.R., Costa R.M., Mainen Z.F. (2014) *Big behavioral data: psychology, ethology and the foundations of neuroscience.* Nature Neuroscience 17(11): 1455-62..

Gouvêa T.S., Monteiro T., Soares S., Atallah BV, Paton J.J. (2014) *Ongoing behaviour predicts perceptual report of interval duration.* Frontiers in Neurorobotics Mar 11;8:10.

Zhang W, Schneider DM, Belova MA, Morrison SE, Paton JJ, Salzman CD. (2013) *Functional Circuits and Anatomical Distribution of Response Properties in the Primate Amygdala.* J Neurosci. 33 (2), 722-733.

Belova MA*, Paton JJ*, Morrison SE, Salzman CD (2007) Expectation modulates neural responses to pleasant and aversive stimuli in primate amygdala. Neuron 55 (6):970-84.

Paton JJ*, Belova MA*, Morrison SE, Salzman CD (2006) *The primate amygdala represents the positive and negative value of visual stimuli during learning.* Nature 439:865-870.

* Equal contribution

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PROJECT

Collaborators

JOSHUA T. DUDMAN, Janelia farm Research Campus, USA)

YI LI, Janelia farm Research Campus, USA,

CHRISTIAN MACHENS Champalimaud Neuroscience Programme.

Low dimensional, continuous monitoring of behaviour

As neurophysiologists a major part of our job is to identify sources of variance in the firing patterns of neurons. In many parts of the brain, ongoing behaviour is a major source of neuronal firing variance. However, experiments in cognitive neuroscience generally sample behaviour very sparsely (~0.1 Hz) as compared to the rate of neural data acquisition. As part of the HHMI Janelia Farm Visiting Scientist program and in collaboration with Josh Dudman, we have developed a compact electronic device for measuring behaviour at the same timescale that we monitor neural activity. This "behavioural headstage" contains integrated circuitry for measuring acceleration and tilt along three axes, multiple colored LEDs for video tracking, leads for electromyographs, and a small CMOS camera for capturing rat-centric video during cognitive tasks. To this approach, we have added and invested heavily in high speed video recording of behaviour and analysis of the resulting data. Our initial observations have resulted in a manuscript "Ongoing behaviour predicts perceptual report of interval duration" that was published in early 2014.

PROJECT

Funding

Fellowships — Fundação para a Ciência e a Tecnologia (FCT).

Optogenetic investigation of interval timing in mice

In the past year, we have initiated a parallel set of timing studies in mice in order to take advantage of the increased molecular power of the mouse relative to the rat. We have trained mice on a classic temporal reproduction task, called the peak interval task, and are currently training mice on an SFI task. By combining viruses dependent on CRE recombinase activity for expression of transgenes, with mouse lines expressing CRE in specific basal ganglia cell types, we plan to express light sensitive channels and pumps in targeted locations within the basal ganglia circuit. Stimulating these proteins with light during experiments will provide us with two potentially powerful pieces of data. First, we will be able to ask what type of cell we are recording from in vivo much more easily and in higher volume than was available with older techniques. Second, we can test hypotheses about the role of activity in specific populations of neurons for timing behaviour. We have progressed significantly in this project by stimulating Dopamine neurons in the midbrain during performance of the SFI task mentioned above. We find consistent effects of stimulating DA neurons that suggest a slowing of internal timing mechanisms. Initial results indicate that inhibition DA neuron activity optogenetically speeds internal timing mechanisms. In addition, we are performing more anatomically limited perturbations of the DAergic system to identify where in the brain our manipulations are having their effects.

PROJECT

Funding

Grants – Bial Foundation;

Fellowships – Fundação para a Ciência e Tecnologia (FCT)

Neurophysiology of time encoding in the rodent striatum

Lesion, pharmacology, and genetic studies all suggest that the ability to estimate the passage of time on the scale of seconds to minutes is produced in the striatum, a major input area of the basal ganglia. Thus, we trained rats to estimate time intervals and recorded from striatal neurons as they behaved and asked how the passage of time could be encoded in the firing patterns we observed. In addition, the basal ganglia is thought to implement reinforcement learning mechanisms, helping the animal learn how to act in response to a given situation based on past experience. We sought to place the neural signals we recorded into a computational framework that reconciles interval timing and reinforcement learning. Towards that end, we are developing a computational model of interval timing that includes signals related to those we observe experimentally, but that also can solve reinforcement learning problems. The manuscript resulting from these experiments has been reviewed and is currently under revision. (Mello, G.M., Soares, S., and Paton, J. J. A scalable population code for time in the striatum). As part of this process, we have trained more rats and are performing inactivation and cooling experiments, as well as recording simultaneously in cortex and the basal ganglia to better understand how the neural signals we have already recorded are constructed.

PROJECT

Funding

Grants – Simons Foundation collaboration on the Global Brain;

Fellowships – Fundação para a Ciência e Tecnologia (FCT)

Neurometric - Psychometric comparison of interval timing performance

Tasks in which subjects must categorise sensory stimuli whose characteristics are parametrically varied have been powerful tools for relating neural processing to sensation in a rigorous and quantitative manner. We are applying the same approach to an unconventional sensory modality, the ability to sense the passage of time, by training rats on a two alternative forced choice interval timing task. We can derive quantitative description of animals' interval timing abilities via the fitting of psychometric functions to their choice data and then compare this to the ability of neural activity to encode the passage of time. A tight correspondence between the animals' behavioural performance and the neuronal encoding of time would suggest involvement of those neural signals in the process of timing. We are testing hypotheses about how time is encoded in neural populations generated by the experiments described above by recording neural activity in the same brain area (striatum) during this two alternative forced choice temporal discrimination task. We have recorded > 600 neurons from three rats performing this task, while simultaneously collecting high speed video of animals' behaviour and the analysis of the resulting data is ongoing. In addition, we have begun to train transgenic rats that will allow us to optogenetically manipulate dopamine neurons that have been implicated in action production, learning, and timing, during this task.

PROJECT

Funding

Fellowships – Fundação para a Ciência e Tecnologia (FCT)

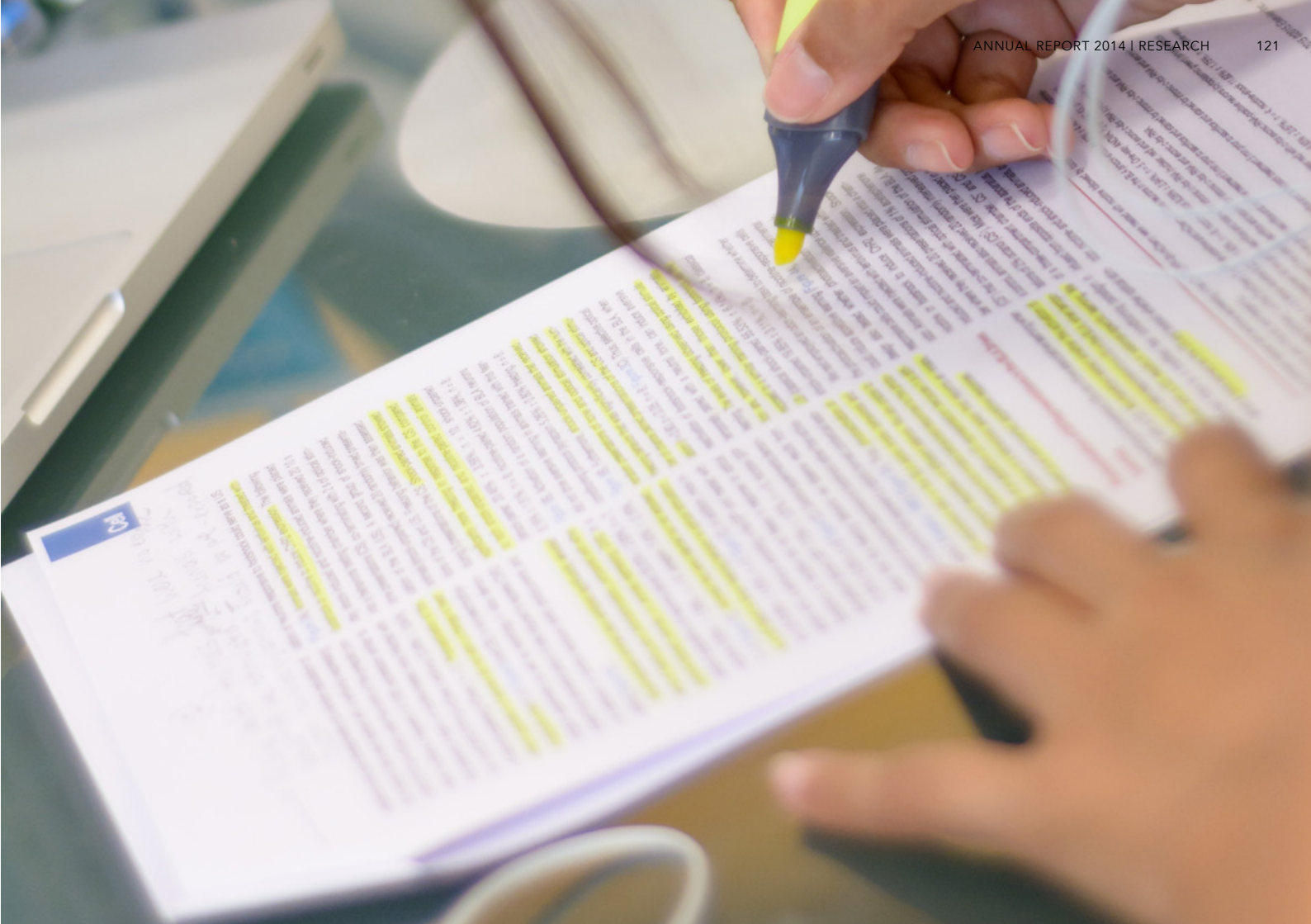
The role of Dopamine in value-based decision-making

Our interest in time encoding in the brain stems from an ultimate interest in how animals learn to evaluate the various options presented to them in order to produce adaptive behaviour. Recently, the lab has initiated a project to directly study the neural mechanisms underlying this process of evaluating choice options in the context of value-based decisions. Multiple lines of evidence suggest that DA neurons in the midbrain broadcast a reward prediction error that in reinforcement learning models acts to update the value of stimuli and actions. However, questions remain about the causal role of DA in this process. Specifically, we have trained mice to decide between two choice options depending on their recent history of choices and reward outcomes that resulted from those choices. To test for a causal role of DA neuron firing in the updating of action value, we are expressing ChR2 and Arch in midbrain DA neurons and exciting and inhibiting their activity just after animals have selected their choice. We have found that indeed, DA stimulation appears to increase the value attributed to the prior choice, and surprisingly, that as little as one 10ms pulse of blue light appears to be sufficient to affect animals subsequent choices. We are currently conducting more experiments to confirm this preliminary data, as well as performing similar experiments using arch to test the causal role of observed pauses in DA neuron firing in decreasing the value of prior stimuli and actions.

ADDITIONAL COLLABORATORS

ADAM KAMPFF, Champalimaud Neuroscience Programme, Portugal. (Learning how to interact with a dynamic environment: the role of motor cortex).

BRIAN LAU, Brain and Spine Institute, INSERM, Paris FR. (How the basal ganglia forces cortex to do what it wants.)



CORTICAL CIRCUITS

LEOPOLDO PETREANU
Principal Investigator

Champalimaud Foundation

The neocortex plays a key role in sensory perception and higher cognitive functions. Unravelling how this seemingly simple sheet of neurons allows so many complex behaviours is one of the great challenges of neuroscience. Our overall goal is to understand the neural computations underlying cortical function. We approach this question by a combination of novel *in vivo* and *in vitro* methods to study the structure and function of cortical circuits. Using optical and electrophysiological techniques in brain slices we study the wiring diagram of cortical circuits. We also measure the activity of the same circuits in head-fixed behaving animals using two-photon imaging. This combined approach allows us to understand both the computations implemented by cortical circuits as well as how they emerge from the underlying neuronal network. By using this approach we will test whether conserved circuits motifs perform similar computations across the neocortex. We will study the functional and structural similarities of repeated subnetworks made by neighbouring neurons within a cortical area as well as those constituted by neurons in different cortical areas interacting through long-range cortico-cortical connections.

KEY PUBLICATIONS

Petreanu L, Gutnisky DA , Huber D, Xu N, O'Connor DH, Tian L, Looger L, Svoboda K (2012). *Activity in motor-sensory projections reveals distributed coding in somatosensation.* Nature. 489:299-303.

Jacob V*, Petreanu L*, Wright N, Svoboda K, Fox K (2012). *Regular spiking and intrinsic bursting pyramidal cells show orthogonal forms of experience- dependent plasticity in layer V of barrel cortex.* Neuron. 73 (2):391-404.

Petreanu L, Mao T, Sternson SM, Svoboda K (2009). *The subcellular organisation of neocortical excitatory connections.* Nature. 457:1142-5.

Petreanu L, Huber D, Sobczyk A, Svoboda K (2007). *Channelrhodopsin-2- assisted circuit mapping of long-range callosal projections.* Nat neurosci. 10(5):663-8.

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PROJECT

Funding

Grants – FP7-People (Marie Curie CIG);

Fellowships –Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation.

Optogenetic circuit mapping of long-range cortical interactions

A comprehensive characterisation of the precise neuronal types constituting cortico-cortical circuits is necessary to understand their function. Feedforward connections terminate mainly from layer 2/3 to layer 6. In contrast, feedback connections terminate in all layers except layer 4. Thus, as the dendrites of cortical neurons usually span several layers, cortico-cortical axons can potentially make synapses with almost any neuronal type in the cortical column. However, as the overlap of axons and dendrites is not always a good predictor of actual connectivity, connections need to be probed with functional methods. Using channelrhodopsin-assisted circuit-mapping we are identifying the postsynaptic targets of afferents from different cortical areas. By mapping the connections linking cortical areas we aim at understanding the logic of feedfoward and feedback connectivity.

PROJECT

Funding

Grants – Human Frontiers Science Programme (HSFP); Champalimaud Foundation.

Optical recordings of feedforward and feedback cortical connections in behaving animals

In order to address the functional roles of feedforward (FF) and feedback (FB) circuits we plan to record from cortico-cortical projections in animals engaged in behavioural tasks that depend on these circuits. Toward this goal, we are developing head fixed behaviours that require several interconnected visual areas. Head-fixed behavioural paradigms allow us to have precise stimulus control and motor readout over a large number of trials with high repeatability. Head-fixed behaviours also facilitate experimental access for the manipulation and recording of neuronal activity. In particular, they allow us to perform optical recordings of neuronal activity in behaving animals. Using two-photon microscopy and genetically-encoded calcium indicators we record specifically from FF and FB projections by imaging afferent axons in their target area. Recordings cortico-cortical circuits together with precise measurements of sensory, motor and behavioural variables will help us in understanding the role of these connections in cortical computation.

PROJECT

Funding

Grants – Human Frontiers Science Programme (HSFP);

Collaborators

LIN TIAN, University of California Davis

Assessing the function of neocortical Layer 1 with genetically-encoded indicators of synaptic activity

Given its anatomical organisation, it is clear that Layer (L)1 of the neocortex plays a key role in cortical function. Despite the vast amount of neocortical recordings amassed over the past decades, L1 remains largely uncharacterised. We are developing novel specialised sensors for studying the connections linking distant brain regions to L1 together with our collaborator Lin Tian from the University of California. We will apply these novel sensors, to describe the basic functional organisation of L1. We will characterise afferent activity from cholinergic and non-specific thalamic projections to L1 in behaving animals. Our project will shed light on the functional organisation of L1. Importantly, the tools to be generated will have wide applications in neuroscience by allowing recordings from afferent inputs of any length scale and relating their function with connectivity.

PROJECT

Funding

Grants – FP7 Cooperation. (Neuroseeker).

Collaborators:

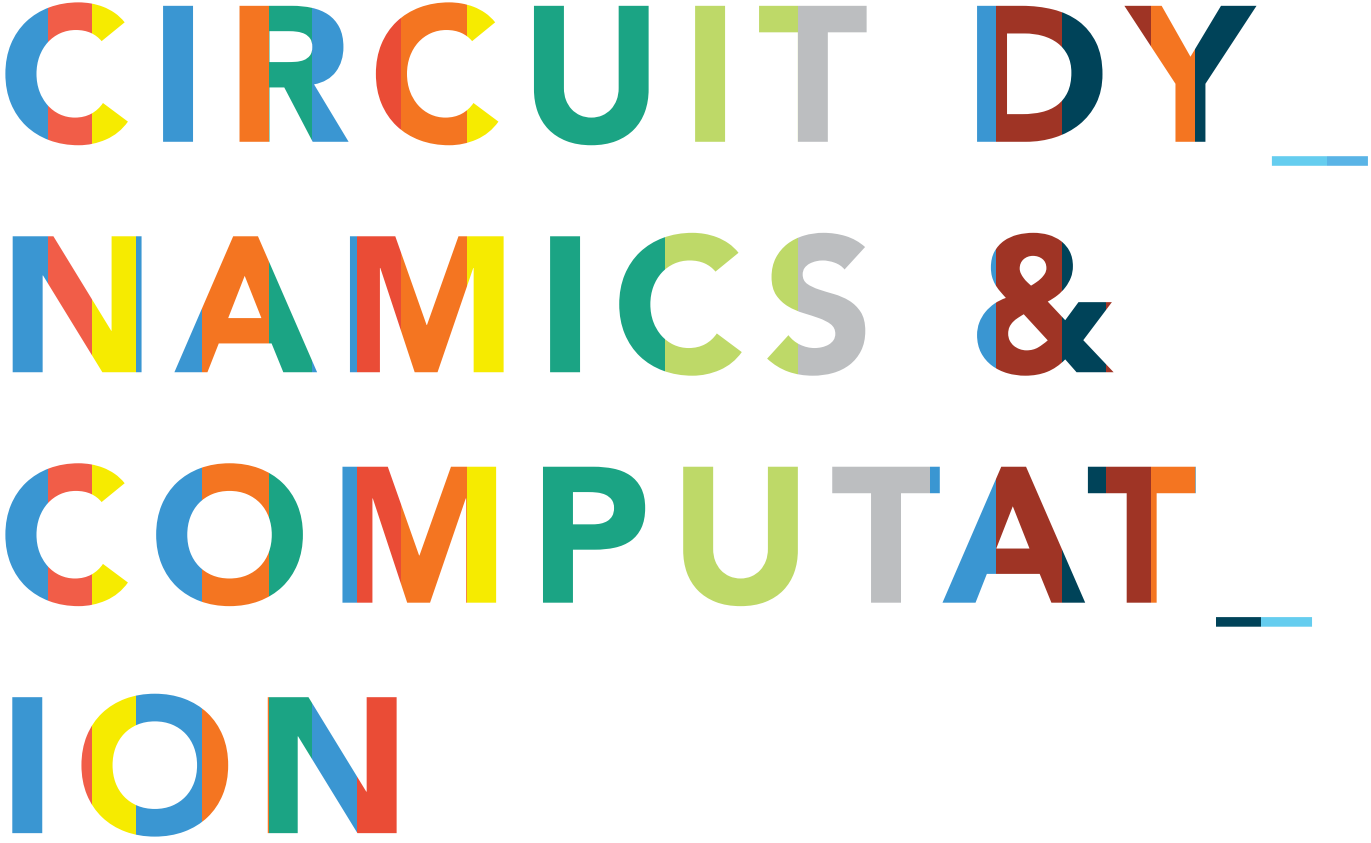
ALFONSO RENART, ADAM KAMPFF, Champalimaud Neuroscience Programme

ADDITIONAL COLLABORATORS

LIN TIAN, University of California Davis, USA.

Validation of novel electrodes with optical and intracellular recording techniques

Together with Alfonso Renart and Adam Kampff we are developing a two-photon (2P) microscope capable of simultaneous in vivo extracellular recordings with NeuroSeeker probes and targeted intracellular recording. We also plan to validate the 'electrical image' acquired by NeuroSeeker probes using optical *in vivo* two-phton Ca2+ imaging of neuronal population activity in the vicinity of the electrode.


CIRCUIT DY_
NAMICS &
COMPUTAT_
ION

ALFONSO RENART

Principal Investigator

Champalimaud Foundation

We are interested in identifying generic principles governing the dynamics of cortical circuits and the way in which they produce function. Our current work evolves around two lines of research: auditory processing – with an emphasis on how the activity of auditory cortical populations evolves in time in response to sound and internal variables, and how these time-varying responses guide behaviour – and working memory, with a focus on the mechanisms underlying the maintenance of information across time. Our research strategy relies both on identifying characteristic signatures of population organisation – through recordings of the simultaneous activity of neuronal populations during controlled behavioural tasks – as well as on developing a mechanistic understanding of how these patterns of population activity emerge – which we investigate by developing mathematical models of the underlying neuronal circuits.

KEY PUBLICATIONS

Renart A, Machens CK (2014). *Variability in neural activity and behaviour.* Curr Opin Neurobiol. 25: 211-220.

Renart A, de la Rocha J, Bartho P, Hollender L, Parga N, Reyes A, Harris KD. (2010) *The asynchronous state in cortical circuits.* Science. 327:587-590 .

Renart A, Moreno-Bote R, Wang XJ, Parga N. (2007). *Mean-Driven and Fluctuation-Driven Persistent Activity in Recurrent Networks.* Neural Comput 19(1):1-46.

Renart A, Song P, Wang XJ (2003). *Robust spatial working memory through homeostatic synaptic scaling in heterogeneous cortical networks.* Neuron. 38 (3): 473-485.

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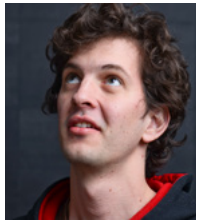

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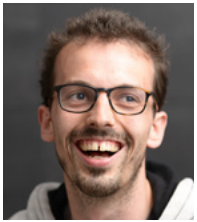

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PROJECT

Funding

Grants – FP7-People (Marie Curie); FP7-Cooperation (Neuroseeker);

Fellowships – Brazilian CNPq Postdoctoral Fellowship.

Brain-state dependence of cortical population dynamics

Although the classical approach in Neuroscience has been to establish neural correlates of sensory or action-related variables, which are measurable and to a large extent controllable by the experimenter, the activity of neurons in many brain areas, including the cortex, is strongly dependent on global internal variables that modulate the organism as a whole, such as arousal, motivation, etc. Such variables, which determine what is typically referred to as brain-state, depend on the action of neuro-modulatory systems and, due to their global nature, have a very large impact on patterns of neural activity at the population level. We are interested in characterising how the dynamics of populations of neurons in (sensory) cortex depend on brain-state, focusing on states of activation or desynchronisation, typical of attentive wakefulness, but which can also be generated pharmacologically under anesthesia. We study the statistical structure and functional role of spontaneous activity fluctuations in cortical populations and their relationship with evoked sensory responses, in order to get a better understanding of the nature of neural variability and its impact on behaviour.

PROJECT

Funding

Grants – FP7-People (Marie Curie); FP7-Cooperation (Neuroseeker);

Fellowships – Human Frontiers Science Programme (HFSP); Norwegian Research Council (NRC).

Collaborators

JAIME DE LA ROCHA and ALBERT COMPTE
DIBAPS, Spain

Circuit basis of simple auditory judgements

We are using auditory discrimination tasks in rodents, together with large-scale cortical population recordings and theory, in order to study the circuit basis of simple sensory judgements. We focus on several aspects of this problem, such as the population structure of trial-to-trial variability in auditory cortex and its relationship to behavioural accuracy, the way in which external sensory evidence is combined with prior expectations in local auditory cortical circuits, the role of different, genetically-identified cell types, in shaping the overall dynamics of spontaneous activity and evoked auditory responses, and the functional role of such dynamical, time-varying activity patterns in the context of auditory categorizations.

PROJECT

Funding

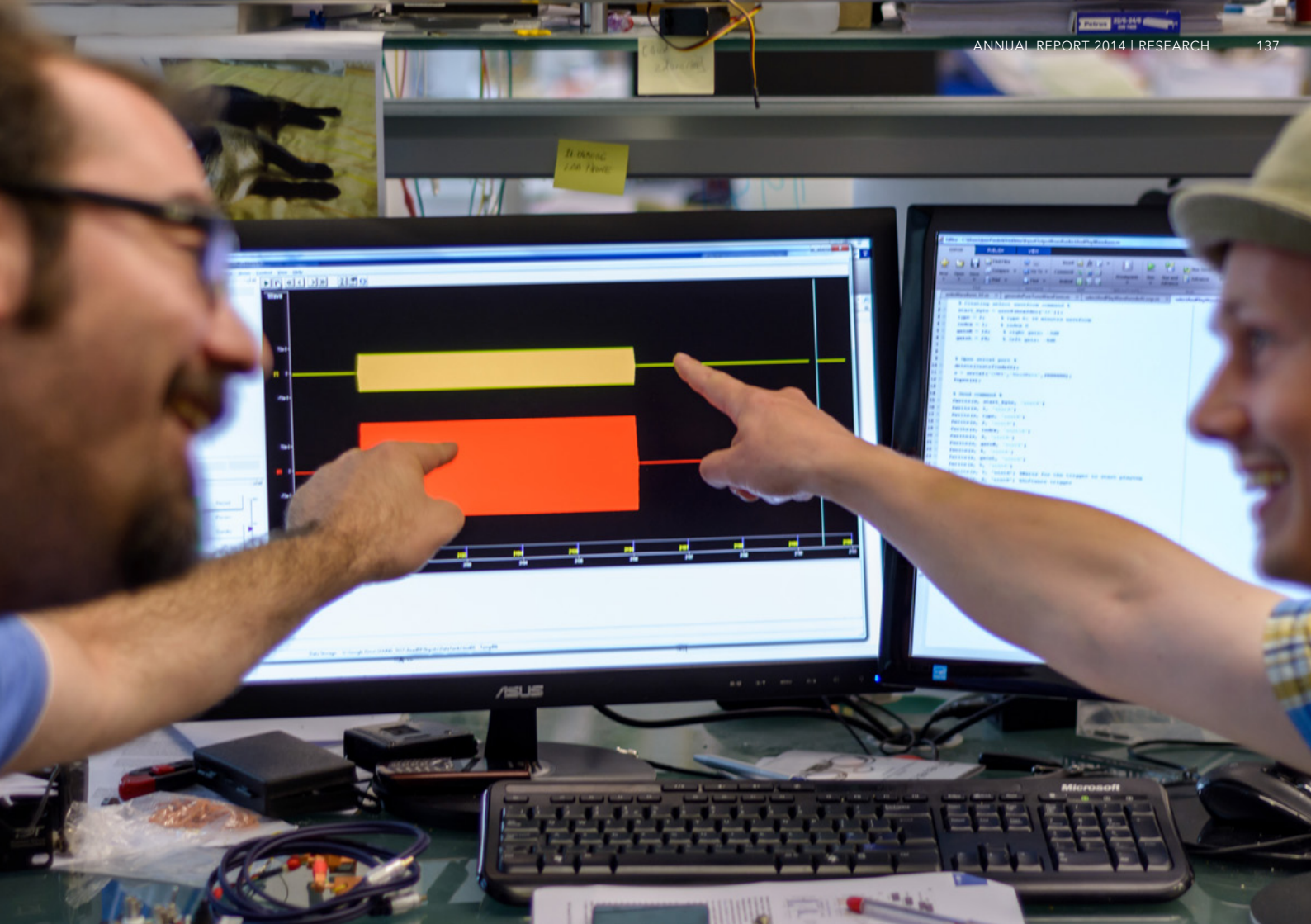
Grants - Human Frontiers Science Programme (HFSP) Young Investigator Award

Collaborators

PAUL CHADDERTON, Imperial College London, UK ; SEBASTIAN ROYER, Centrefor Functional Connectomics, Seoul, Korea.

The dynamical basis of working memory

To guide behaviour, it is sometimes necessary to actively maintain or manipulate information which has been previously experienced, but is no longer present in the environment – an ability referred to as Working Memory. The prefrontal cortex has been identified as a key brain area in this process, and recent work is suggesting an important role for sensory areas in working memory as well. In this project we are interested in characterising the structure of working memory representations at the population level, in quantifying their dynamical stability, and in investigating the contribution of sensory and frontal areas to working memory function in mice. Our goal is to combine careful behavioural analysis, electrophysiology, optogenetics and modeling to provide a dynamical foundation for this important cognitive ability.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BEHAVIOUR AND META_ BOLISM

CARLOS RIBEIRO

Principal Investigator

Champalimaud Foundation

Nutrition is a key determinant of health, wellbeing and aging. We want to understand how animals decide what to eat and how these decisions affect the fitness of the animal. To achieve a mechanistic, integrated, whole-animal understanding of nutritional decision-making we work at the interface of behaviour, metabolism and physiology in the adult *Drosophila melanogaster*. The powerful neurogenetic tools available in this model organism allow us to identify molecular as well as circuit mechanisms involved in producing the appropriate behavioural response to a specific need of the fly. We also dedicate a significant effort to the development of novel, automated and quantitative behavioural assays to understand the behavioural strategies used by the fly to maintain nutritional homeostasis. The combination of powerful genetics, sophisticated behavioural analyses, and imaging approaches allows for a mechanistic understanding of how neuronal circuits control nutritional decisions to regulate important traits such as aging and reproduction.

KEY PUBLICATIONS

Itskov PM, Moreira JM, Vinnik E, Lopes G, Safarik S, Dickinson MH, Ribeiro C (2014). *Automated monitoring and quantitative analysis of feeding behaviour in Drosophila.* Nat Commun. 5:4560.

Piper MDW, Blanc, E, Leitão-Goncalves R, Yang, M, He, X, Linford NJ, Hoddinott MP, Hopfen C, Soultoukis GA, Niemeyer C, Kerr F, Pletcher SD, Ribeiro C, Partridge L (2013). *A holidic medium for Drosophila melanogaster.* Nat Methods. 11: 100-105.

Ribeiro C, Dickson BJ (2010) *Sex Peptide Receptor and Neuronal TOR/ S6K Signaling Modulate Nutrient Balancing in Drosophila.* Current Biology 20 (11):1000-1005.

Yapici N, Kim Y-J, Ribeiro C, Dickson BJ (2008) *A receptor that mediates the post-mating switch in Drosophila reproductive behaviour.* Nature 451:33-7.

Ribeiro C, Neumann M, Affolter M (2004) *Genetic control of cell intercalation during tracheal morphogenesis in Drosophila.* Curr Biol 14 (24):2197-2207.

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Discovery.V8
SteREO

PROJECT

Funding

Grants - Fundação para a Ciência e a Tecnologia (FCT), Bial Foundation;

Fellowships - EMBO;

Champalimaud Foundation

Collaborators

DR. MATTHEW PIPER , Institute of Healthy Ageing, University College London, UK;

DR. JOHN POSPISILIK Max Planck Institute for Immunology and Epigenetics, Germany

What are the internal state variables affecting nutritional decisions?

Animals choose which nutrients to eat according to their current needs. We are dissecting the effects of specific nutrients and metabolic pathways on nutritional decision-making. For this we use a novel chemically defined medium that is adequate for adult traits, such as behaviour, fecundity and lifespan to study the impact of specific nutrients on feeding behaviour. Using detailed and quantitative behavioural analyses of food choice and feeding behaviour we for example show that specifically removing amino acids from the diet leads to a change in foraging culminating in an increased ingestion of proteinaceous food. These data shed light on the exquisite behavioural sensitivity of flies to the lack of single nutritional components and the foraging strategies used to achieve nutrient homeostasis.

PROJECT

Funding

Grants – Human Frontiers Science Program (HFSP);

Fellowhips - Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation

Collaborators

PROF. MICHAEL DICKINSON Caltech, USA;

DR. ALDO FAISAL, Imperial College London, UK;

What are the behavioural strategies used by the animal to find, identify and decide which nutrients to eat?

Drosophila has become a powerful model organism in neuroscience research not only due to its molecular genetics toolkit, but also due to the successful development of methods and protocols to monitor and annotate behaviour. Feeding and foraging are central elements in a majority of behavioural assays, but their quantification and analysis is a major challenge in the fly. We have developed flyPAD - fly Proboscis and Activity Detector, a method to automatically monitor feeding behaviour quantitatively in individual flies. Our method is based on capacitive measurement of a fly's interaction with the food. The precision of the measurements allows for high fidelity, high temporal resolution, and unbiased measurements of feeding behaviour. We demonstrate that flies ingest food by rhythmically extending their proboscis with a frequency that is not modulated by the internal state of the animal. Instead, hunger and satiety homeostatically modulate the microstructure of feeding. These results highlight similarities of food intake regulation between insects, rodents, and humans, pointing to a common strategy in how the nervous systems of different animals control food intake. This method complements our continuing experimental and quantitative modeling approaches to understand how the internal state affects foraging and feeding strategies to achieve nutrient homeostasis.

PROJECT

Funding

Grants - Fundação para a Ciência e a Tecnologia (FCT), Bial Foundation;

Fellowships - Fundação para a Ciência e a Tecnologia (FCT), EMBO;

Champalimaud Foundation.

What are the molecular mechanisms used by the brain to choose the correct food?

At the centre of developing and deploying optimal strategies for nutrient uptake and utilisation lies the ability of the central nervous system to detect the internal availability of nutrients and to use this information to induce changes in the behaviour as well as metabolism of the animal. We are investigating how conserved nutrient sensing pathways act in the nervous system to control feeding. Furthermore, analysing genes identified as being required for nutrient decisions in large-scale neuronal RNAi screens we are investigating novel molecular mechanisms mediating nutrient homeostasis. Taken together these studies are allowing us to study nutrient balancing and value-based decision making at the molecular level.

PROJECT

Funding

Grants – Human Frontiers Science Program, FP7-People (Marie Curie ITN), Fundação para a Ciência e a Tecnologia (FCT);

Fellowhips - Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation

What are the neuronal circuit mechanisms used by the brain to choose the correct food?

Our current knowledge of the neuronal circuit mechanisms underlying nutrient decisions is very poor. By combining genetic approaches with high throughput behavioural screens we have identified multiple neuronal populations required for nutrient homeostasis. We are currently conducting in depth analyses of the function of these neurons using quantitative behavioural approaches and activity imaging as well as characterising the molecular and cellular mechanisms acting in these neurons to mediate nutrient decisions.

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NOAM SHEMESH

Principal Investigator

Champalimaud Foundation

Modulations in neural circuit dynamics and microstructures can translate to functional enhancements (e.g., upon plasticity), or, conversely, to severe functional deficits (e.g., upon neurodegeneration or neuropsychiatric disease progression). We are interested in identifying and investigating the links between such longitudinal functional modulations, their underlying micro-architectural modifications, and the ensuing behavioural responses in vivo. To this end, we harness ultrahigh field Magnetic Resonance Imaging (MRI) coupled to specificity-endowing modalities such as optogenetics and optical microscopy. These offer the opportunity of eliciting activity in circuits of interest, and concomitantly monitoring the ensuing activity in 3D. We further develop and apply novel methodologies based on nonBOLD mechanisms, which can potentially provide much insight into the nature of the activity, as well as probe rather fast dynamics. Microstructures are unraveled via MR methodologies tailored to probe cellular-scale size distributions (in white matter) as well as highly heterogeneous morphologies (in gray matter). These measurements are performed in vivo using state of the art 9.4T and 16.4T scanners, in both anesthetized and behaving rodents, as well as in animal models of neurodegeneration and plasticity. Our long term goals are to understand the mechanisms by which modifications in the tissue's microstructure transcend globally and modulate function and behaviour, and to explore the potential of these as early disease biomarkers.

KEY PUBLICATIONS

Shemesh N, Rosenberg JT, Dumez JN, Muniz JA, Grant SC, Frydman L (2014). *Metabolic properties in stroked rats revealed by Relaxation-Enhanced in-vivo Magnetic Resonance Spectroscopy at ultrahigh fields.* Nat Commun. 5:4598.

Shemesh N, Rosenberg JT, Dumez JN, Grant SC, Frydman L (2014). *Metabolic T1 Dynamics and Longitudinal Relaxation Enhancements (LREs) in vivo at Ultrahigh Magnetic Fields upon Ischemia.* J Cereb Blood Flow Metab. 34:1810-1817.

Shemesh N, Westin CF, Cohen Y (2012). *Magnetic Resonance Imaging by synergistic diffusion-diffraction patterns.* Phys Rev Lett. 108: 058103.

Shemesh N Cohen Y (2011). *Microscopic and compartment shape anisotropies in gray and white matter revealed by angular bipolar double-PFG MR.* Magn Reson Med. 65:1216-1227.

Shemesh N, Adiri T, Cohen Y (2011). *Probing microscopic architecture of opaque heterogeneous systems using double-Pulsed-Field-Gradient NMR.* J Am Chem Soc. 133:6028-6035.

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700WB

PROJECT

Funding

Fellowships - Fundação para a Ciência e a Tecnologia (FCT);

Champalimaud Foundation

Deciphering distributed neural circuits via advanced fMRI coupled with optogenetics

Complex behaviours ultimately arise from neural activity in widespread, distributed systems in the brain. We are interested in deciphering such networks in awake behaving rodents via optogenetics and advanced ultrafast fMRI. To achieve this goal, we are currently developing optogenetics and MRI-compatible behavioural paradigms for awake rodents, as well as advanced ultrafast MRI acquisition strategies that will enable the resolution of relatively fast dynamics. The long term goals include the identification of distributed circuits and the investigation of their causal dynamics.

PROJECT

Funding

Grants – FP7-People (Marie Curie Individual Fellowship);

Champalimaud Foundation

Functional MRI via non-BOLD mechanisms

The success of functional-MRI (fMRI) stems from its ability to portray active brain regions upon prescribing a specific task. However, fMRI relies on the Blood-Oxygenation-Level-Dependent (BOLD) mechanism, which is a surrogate marker for neural activity via neurovasculature couplings. A major goal of the Lab will therefore be to harness MRI's versatility – especially at the ultrahigh fields – towards capturing signatures for neural activity more directly. Specifically, we are interested in detecting cellular swellings upon activation, as well as neurotransmitter releases in the activated regions. Both phenomena can be considered epitomes of neural activity, and their direct detection is expected to provide much insight into the nature of the ensuing activity. We are investigating

these phenomena – as well as BOLD neurophysiology – via MRI coupled to orthogonal modalities such as optical microscopy and optogenetics, in numerous settings from organotypic cultures (where hemodynamics are absent) to *in vivo* rodents.

PROJECT

Microstructural determinants of functional modulations leading to behavioural changes in healthy and diseased CNS

Funding

Grants – FP7-People (Marie Curie Individual Fellowship);

Champalimaud Foundation

Collaborators

PROF. CHUNLEI LIU
Duke University, USA,
PROF. DEREK JONES
Cardiff University, UK

Modulations in brain function (e.g., enhancements arising from plasticity or aberrations arising from neurodegeneration) are intimately correlated with underlying micro-architectural modifications in the neural tissues. We are interested in studying the links between the two, *in vivo*, in a longitudinal fashion in animal models of plasticity on the one hand and neurodegeneration on the other hand. We investigate functional modulations (such as neural network reorganizations) using optogenetics as the specific source of stimulation, and BOLD- and nonBOLD-fMRI as the functional readouts. We augment this functional information with advanced *in vivo* MRI methodologies that are selectively designed to probe even subtle changes in microstructures arising from plasticity or, conversely, neurodegenerative processes. We target microstructural changes in white matter, where we study variations in axonal size distributions (that govern the conduction velocity) as well as in gray matter, where we study changes in randomly oriented tissue components. We further aim to investigate the diagnostic potential arising from the identification of structural changes preceding functional/behavioural modifications.

ADDITIONAL COLLABORATORS

DR. IVANA DROBNJAK,
University College London, UK.

INNATE BEHAVIOUR

MARIA LUÍSA VASCONCELOS
Principal Investigator

Champalimaud Foundation

Animals exhibit behavioural repertoires that are often innate and result in stereotyped sexual and social responses to their environment. Innate behaviours do not require learning or experience and are likely to reflect the activation of developmentally programmed neural circuits. We are interested in the nature of defined neural circuits: how activation of circuits elicits specific behaviours.

It has been extremely difficult in complex organisms to study a circuit beyond the early stages of sensory processing. *Drosophila melanogaster* is an attractive model system to understand a circuit because flies exhibit complex behaviours that are controlled by a nervous system that is numerically five orders of magnitude simpler than that of vertebrates. We use a combined behavioural, genetic and imaging approach to determine how defined neural circuits and their activation elicit specific behaviours.

KEY PUBLICATIONS

Bräcker L, Siju KP, Varela N, Aso Y, Zhang M, Rubin GM, Vasconcelos ML, Grunwald-Kadow I (2013). *CO2 avoidance requires mushroom body output in a feeding state-dependent manner in Drosophila.* Curr Biol. 23:1128-34.

Ruta V, Datta SR, Vasconcelos ML, Freeland J, Looger LL, Axel R (2010). *A dimorphic pheromone circuit in Drosophila from sensory input to descending output.* Nature. 468:686-90.

Datta SR*, Vasconcelos ML*, Ruta V, Luo S, Wong A, Demir E, Flores J, Balonze K, Dickson BJ, Axel R (2008). *The Drosophila pheromone cVA activates a sexually dimorphic neural circuit.* Nature. 452:473-7.

Zhan XL, Clemens JC, Neves G, Hattori D, Flanagan JJ, Hummel T, Vasconcelos ML, Chess A, Zipursky SL (2004). *Analysis of Dscam diversity in regulating axon guidance in Drosophila mushroom bodies.* Neuron. 43 (5):673-86.

Hummel T*, Vasconcelos ML*, Clemens JC, Fishilevich Y, Vosshall LB, Zipursky SL (2003). *Axonal Targeting of Olfactory Receptor Neurons in Drosophila is Controlled by Dscam.* Neuron. 37 (2):221-231.

* Equal contribution

LAB MEMBERS

Sophie Dias
Lab manager

Cecilia Mezzera
Postdoctoral Researcher

Márcia Aranha
Postdoctoral Researcher, FCT Fellow

Nélia Varela
Postdoctoral Researcher, FCT Fellow

Dennis Herrmann
INDP 2008
PhD Student

Eliane Ochôa Arez
PCGD PhD Student

Ricardo Zacarias
INDP 2001 PhD Student, FCT Fellow

Miguel Gaspar
Research Technician

Hugo Cachitas
Research Technician

PROJECT

Funding

Grants – Fundação para a Ciência e a Tecnologia (FCT);

Fellowships - Fundação para a Ciência e a Tecnologia (FCT).

Female receptivity

Genetic studies have elucidated how *Drosophila* male courtship behaviour is specified and its circuit components are being dissected at a surprising speed. The circuit of female behaviour, on the other hand, has been largely uncharacterised. We use a behavioural protocol that allows us to selectively inactivate subsets of neurons in the adult flies only. We use this behavioural approach and combine it with anatomical and functional dissection of the circuit.

PROJECT

Funding

Fellowships – Fundação para a Ciência e a Tecnologia (FCT).

Olfactory avoidance processing in the central brain

Olfaction is the oldest and the least understood of the sensory modalities. We propose to study the olfactory system of the fly that is strikingly similar to the mammalian system but with numerical simplicity and a very large genetic toolbox. We will base our studies in carbon dioxide sensing because it generates a strong avoidance response that can be modulated by the internal state and, at the periphery, is processed by a single channel.

PROJECT

Funding

Fellowships – Fundação para a Ciência e a Tecnologia (FCT).

Collaborators

MARTA MOITA
Champalimaud Neuroscience Programme, Portugal

Mechanism of propagation of defense responses in *Drosophila melanogaster*

To address the question of the neural mechanisms social defense responses we propose to use a model system that is both amenable to the search for the neural mechanism of behaviour, while at the same time allowing the study of the behaviour of large groups of individuals. The fruit fly is the ideal model system, for its large collection of powerful genetic tools, a rapidly increasing number of approaches to study neural circuits and expanding set of behavioural paradigms, while at the same time its small size allows the study of the behaviour of large populations. Therefore, we are developing an assay to dissect social defense mechanisms in *Drosophila*.

ASSOCIATED LAB

NEURAL DEVELOPMENT

DOMINGOS HENRIQUE
Principal Investigator

INSTITUTO DE MEDICINA MOLECULAR

Champalimaud Foundation

Our work is focused on the following questions: i) how cell fate decisions are controlled at the single-cell level, and ii) how cell-cell communication functions to coordinate neuronal production in the developing nervous system. In the first question, we are investigating how pluripotent stem cells explore their genetic information to maintain their fate (self-renewal) or commit to differentiation. By monitoring the activity of the pluripotency gene Nanog, combined with mathematical modelling, our work uncovered the existence of significant stochastic gene expression noise in individual ES cells, which we propose allow these cells to explore the pluripotent decision space. Concerning neuronal production, we have focused on the developing neural retina and the role played by Notch signaling in orchestrating cell diversity in this organ, using two different ligands, Dll1 and Dll4.

One of the major aims of our work is to understand how the pluripotent state is regulated, and how cells exit this state to initiate their progression into lineage commitment. Our approach involves a detailed quantitative analysis of the pluripotency network at the single-cell level in ESCs, and we have recently shown that fluctuations in Nanog expression is a cell-intrinsic property of ESCs that allow them to explore available lineage options in the pluripotent space (Abranches et al, Development 2014).

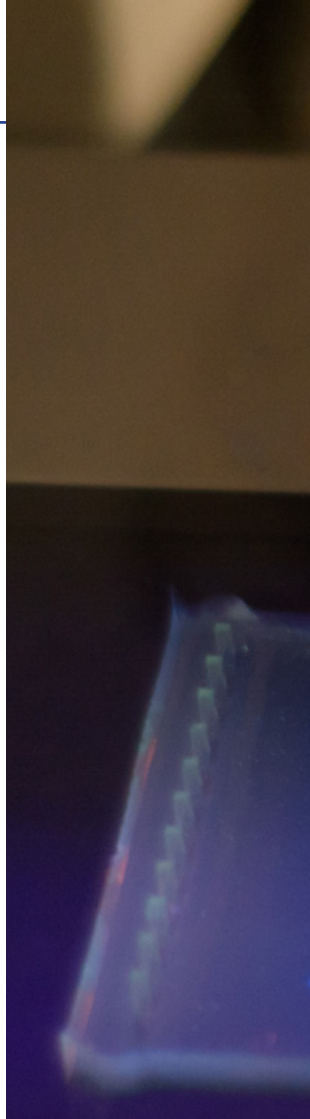
Another achievement of the lab was the identification of a combination of 3 Transcription Factors that can promote a direct transdifferentiation towards inner ear hair cells (HCs), opening new perspectives on the regulation of HC production and how these can be used for human cellular therapies aimed at curing deafness (Aida Costa et al, Development, in press).

LAB MEMBERS

Elsa Abranches
Postdoctoral
Researcher, FCT Fellow

Ana M. Guedes
MIT-Portugal PhD
Student, FCT Fellow

Pedro Barbacena
Research Assistant



ASSOCIATED LAB

SOCIAL NEUROENDOCRINOLOGY

RUI OLIVEIRA

Principal Investigator

Instituto Superior
de Psicologia Aplicada /
Instituto Gulbenkian de Ciência

Champalimaud Foundation

Our main research interest is the integrative study of social behaviour, which combines the study of proximate causes (gene modules, hormones, neural circuits, cognitive processes) and ultimate effects (evolutionary consequences). In particular we aim to understand how brain and behaviour can be shaped by the social environment, and how the cognitive, neural and genetic mechanisms underlying plasticity in the expression of social behaviour have evolved. Current research questions centre on four topics:

1. Evolution of social cognition and of its neuromolecular mechanisms – we aim to understand if social plasticity is as an organismal performance trait that impacts Darwinian fitness and may itself be subject to selection;

2. Genomic and epigenomic mechanisms of social plasticity – we seek to understand how the same genome can produce different social phenotypes in response to key social cues in the environment;

3. Neuroendocrinology of social interactions and of social plasticity – this research aims to understand the role of hormones and neuropeptides as neuromodulators involved in the plasticity of social behaviour;

4. Fish cognition and welfare – we aim to use our knowledge in this field to improve fish husbandry and handling procedures towards better research and animal welfare.

LAB MEMBERS

João Solari Lopes
Postdoctoral Researcher

Ana Rita Nunes
Postdoctoral Researcher

José Cruz
Research Scientist

Rodrigo Abreu
PhD Student

Magda Teles
PhD Student

Gonçalo Oliveira
PhD Student

Ana Isabel Faustino
PhD Student

Sara Cardoso
PhD Student

Júlia Pinho
PhD Student

André Monteiro
MSc Student

LAB MEMBERS

Ana Cruz
MSc Student

Natália Madeira
MSc Student

Raquel Martins
MSc Student

Ana Sofia Félix
Lab technician

FUNDING

TO FACILITATE THE QUEST OF SCIENTISTS

IN UNDERSTANDING HOW NEURAL CIRCUITS GENERATE BEHAVIOR

The CNP is supported by funds provided by the Champalimaud Foundation and by external funds from a diverse group of national and international organisations.

21M€

Since the establishment of the CNP in 2007, CNP researchers have been awarded a sum of over 21 Million euros in support of their research. These funds were awarded by Portuguese, European, North American and International organisations.

European Organisations:

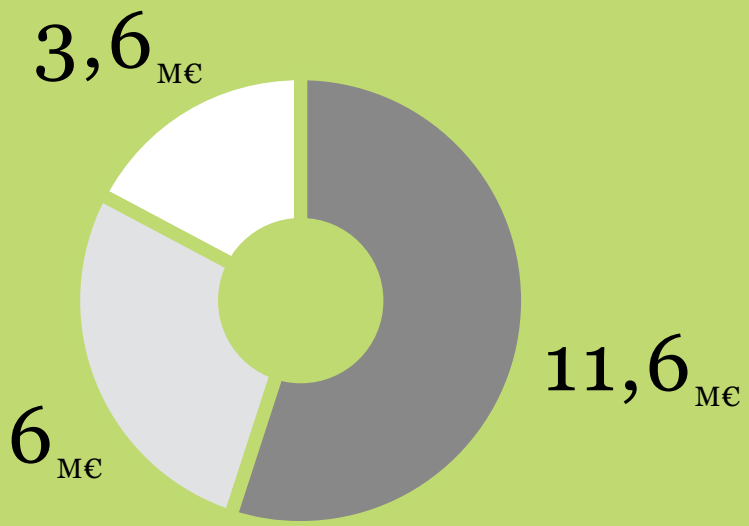
- European Research Council
- Marie Curie Actions
- FP7-Cooperation
- Louis Jeantet Foundation
- Human Brain Project
- ERA-NET

Portuguese Organisations:

- Fundação para a Ciência e a Tecnologia (FCT)
- Fundação Bial

International and North American (US-based) Organisations:

- Howard Hughes Medical Institute
- Human Frontier Science Program Organization
- Simons Foundation



External Funding
2007-2014 (%)

- European Organisations
- Portuguese Organisations
- International and North-American (US based) Organisations

CHAMPALIMAUD NEUROSCIENCE PROGRAMME

Following both phases of the recent review of R&D Units, the CNP was classified as **"Exceptional"**, the highest grade possible in this evaluation. This classification places the CNP among the best research institutes in Portugal, awarding it with support in the form of a budget of approximately 450,000€ per year for the duration of 3 years.

FCT
Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

CARLOS RIBEIRO

In December 2014, Carlos Ribeiro, head of the Behaviour and Metabolism lab, was elected as a member of the first group of **FENS-Kavli Scholars**. This group of 20 young European neuroscience researchers, were chosen for the excellence of their research, as well as their promise to be among the field's newest generation of extraordinary pioneers.

FENS KAVLI
NETWORK OF EXCELLENCE

RUI COSTA

During 2014, Rui Costa received several marks of recognition for his research work.

The first, announced in May, was Dr. Costa's election as an **EMBO member.** With this election, Dr. Costa joined a prestigious group of over 1500 international field-leading scientists, which includes CR Director Zachary Mainen.

In June, the President of the Portuguese Republic awarded Dr. Costa with an **Honorific Portuguese Order**. The event took place on June 10th, the National day of Portugal, Camões and the Portuguese Communities, awarding the Honorific title – Antiga, Nobilíssima e Esclarecida Ordem Militar de Sant'Iago da Espada, do Mérito Científico, Literário e Artístico.

Finally, in July, Dr. Costa received the 2014 Louis-Jeantet Young Investigator Career Award. This award aims to facilitate his work on the neurobiology of action, for which he had received an ERC Starting Grant in 2009.

EMBO

FONDATION LOUIS-JEANTET

- FUNDING HIGHLIGHTS -

EUROPEAN RESEARCH COUNCIL (ERC)

RUI COSTA

Dr. Costa was awarded this **ERC Consolidation Grant** for the research project "Neural bases of action chunking in basal ganglia subcircuits". In this project, the researchers dissect with unprecedented spatial and temporal precision the role of basal ganglia subcircuits in the initiation and performance of action chunks.

2.0M€

ERC Consolidation Grant
Awarded in 2014

MEGAN CAREY

This **ERC Starting Grant** was awarded to Dr. Carey to study the neural circuits that coordinate locomotion in mice. In this project, Dr. Carey's team will work to elucidate the mechanisms through which the cerebellum contributes to locomotion.

1.5M€

ERC Starting Grant
Awarded in 2014

- PROJECTS -

HOWARD HUGHES MEDICAL INSTITUTE

International Early Career Scientist Award
2012-2017
AWARDED TO MEGAN CAREY

International Early Career Scientist Award
2012-2017
AWARDED TO RUI COSTA

FP7 - COOPERATION

BrainFlight
Brain controlled aircraft flight using multiple feedback mechanisms
2012-2014
AWARDED TO AN INTERNATIONAL GROUP OF INVESTIGATORS, INCLUDING RUI COSTA

NeuroSeeker
Investigation of local and global cortical circuits with advanced neural probes for high-resolution electrophysiological monitoring and optogenetic stimulation
2013-2017 (officially announced in 2012)
AWARDED TO AN INTERNATIONAL GROUP OF INVESTIGATORS, INCLUDING ADAM KAMPFF, LEOPOLDO PETREANU AND ALFONSO RENART

FP7

Human Brain Project
Cognitive Architectures. (Decision confidence. Local and global mechanisms.)
2013-2016
AWARDED TO ZACHARY MAINEN

Human Brain Project
Cognitive Architectures
2013-2016
AWARDED TO RUI COSTA

FP7 – ERA-NET

ERA-Net Joint Action
Discovering genetic risk variants for neuropsychiatric disorders and their consequences using dogs, humans and mice.
2014-2017
AWARDED TO RUI COSTA

ERA-Net Joint Action
Uncertainty monitoring vs. inhibition of action in obsessive-compulsive disorder: role of the subthalamic nucleus and effects of stimulation in humans and rodents
2014-2017
AWARDED TO RUI COSTA

FP7-IDEAS (EUROPEAN RESEARCH COUNCIL)

ERC Starting Grant, European Research Council
Cerebellar circuit mechanisms of coordinated locomotion in mice
2015 – 2020 (Announced in 2014)
AWARDED TO MEGAN CAREY

ERC Consolidation Grant, European Research Council
Neural bases of action chunking in basal ganglia subcircuits
2014 – 2019
AWARDED TO RUI COSTA

ERC Starting Grant, European Research Council
Circuits of conspecific observation
2013-2018
AWARDED TO MARTA MOITA

ERC Advanced Grant, European Research Council
Optogenetic Analysis of Serotonin Function in the Mammalian Brain
2010-2015
AWARDED TO ZACHARY MAINEN

ERC Starting Grant, European Research Council
Neural mechanisms of action learning and action selection: from intent to habit
2009-2014
AWARDED TO RUI COSTA

FP7 – PEOPLE (MARIE CURIE)

Marie Curie Career Integration Grant
Neural basis of visually guided walking in the fly
2013-2017
AWARDED TO EUGENIA CHIAPPE

Marie Curie Career Integration Grant
Sound Localisation by Neural Populations in the Rat Auditory Cortex
2013-2017
AWARDED TO ALFONSO RENART

Marie Curie Career Integration Grant
The rules of connectivity of genetically-defined long-range projections
2013-2016
AWARDED TO LEOPOLDO PETREANU

Marie Curie Intra-European Fellowship for Career Development
Neural circuits underlying visually guided behaviour
2011-2015
AWARDED TO MICHAEL ORGER

Marie Curie Initial Training Network Grant
FLiACT—Systems neuroscience of Drosophila: from genes to circuits to behaviour
2012-2016
AWARDED TO CARLOS RIBEIRO

FUNDAÇÃO BIAL

Bial Science Research Grant

Demixing and visualizing neural population activity in higher cortical areas

2015-2016 (Announced in 2014)

AWARDED TO DMITRY KOBAK AND CHRISTIAN MACHENS

Bial Science Research Grant

The role of dopamine in behavioural exploration and action selection

2015-2017 (officially announced in 2014)

AWARDED TO RUI COSTA AND AARON KORALEK

Bial Science Research Grant

Identifying and characterizing the neuronal circuits required for nutrient choice and their effect on aging

2015-2017 (Announced in 2014)

AWARDED TO CARLOS RIBEIRO

Bursary for Scientific Research

Optogenetic circuit dissection of neural instructive signals for cerebellum-dependent learning

2015 – 2018 (Announced in 2014)

AWARDED TO DOMINIQUE PRICHETT AND MEGAN CAREY

Bial Science research Grant

Bridging between events and their consequences: the role of prefrontal cortex

2013-2015

AWARDED TO EKATERINA VINNIK, MARTA MOITA AND ALFONSO RENART

Bial Science Research Grant

Embodied cognition: the neural basis of time encoding in the brain?
2013-2016

AWARDED TO JOE PATON

Bial Science Research Grant

Circuit mechanisms of spatial attention in the zebrafish midbrain

2013-2016

AWARDED TO MICHAEL ORGER

Bial Science Research Grant

Interfacing Technology with the Brain: Novel materials for implantable neural devices

2013-2016

AWARDED TO ADAM KAMPFF

Bial Science research Grant

Defining the functional architecture of motion vision sensitive visual-motor circuit

2013-2016

AWARDED TO EUGENIA CHIAPPE

Bial Science Research Grant

Dopaminergic regulation of dietary learning in humans and rodents

2011-2014

AWARDED TO RUI COSTA

Bial Science Research Grant

Effects of Conditional Foxp2 Deletion on Motor-Sequence Learning

2013-2015

AWARDED TO RUI COSTA AND CATHERINE FRENCH

Bial Science Research Grant

Investigating the function of synaptic competition in memory formation and mental retardation

2011-2014

AWARDED TO INBAL ISRAELY

Bial Science Research Grant

Neural Mechanisms of Social Transmission of Fear

2011-2014

AWARDED TO MARTA MOITA

Bial Science Research Grant

Elucidating the molecular mechanisms mediating feeding behaviour

2011-2014

AWARDED TO CARLOS RIBEIRO

FUNDACÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)

Research Project Grant

Spine dynamics in neural circuit plasticity and mental retardation

2012-2015

AWARDED TO INBAL ISRAELY

Research Project Grant

Decision confidence

2013-2015 (officially announced in 2012)

AWARDED TO ZACHARY MAINEN

Research Project Grant

Comida para pensar: a epigenómica das doenças alimentares

2013-2016

AWARDED TO RUI COSTA

Research Project Grant

Dos neurónios ao comportamento: um estudo exaustivo do comportamento de cortejamento da Drosophila fêmea

2014-2015 (officially announced in 2013)

AWARDED TO MARIA LUíSA VASCONCELOS

Research Project Grant

Neural Control of Locomotor Speed in Zebrafish

2013-2015

AWARDED TO MICHAEL ORGER

Research Project Grant

Dopaminergic Neurotransmission

2012-2014

AWARDED TO RUI COSTA

Research Project Grant

Dissecção das bases moleculares e dos circuitos envolvidos na intenção

2011-2014

AWARDED TO RUI COSTA

Research Project Grant

Identifying and characterising the molecular mechanisms at the basis of nutritional decisions

2012-2015

AWARDED TO CARLOS RIBEIRO

HUMAN FRONTIER SCIENCE PROGRAMME ORGANISATION (HFSPO)

HFSP Young Investigator Award

Assessing the function of neocortical Layer 1 with genetically-encoded indicators of synaptic activity

2013-2016

AWARDED TO LEOPOLDO PETREANU

HFSP Young Investigator Award

The dynamical basis of working memory in the prefrontal cortex

2012-2015

AWARDED TO ALFONSO RENART

HFSP Program Grant

Value-based decision making in Drosophila foraging: genes, computations and behaviour

2012-2015

AWARDED TO CARLOS RIBEIRO

SIMONS FOUNDATION

Project Award

Dissecting Striatal Circuit dynamics during repetitive behaviours in ASD

2014-2015

AWARDED TO RUI COSTA

Project Award

Simons Collaboration on the Global Brain Research Award

How the basal ganglia forces cortex to do what it wants

2014-2017

AWARDED TO JOE PATON

Simons Collaboration on the Global Brain Research Award

Neural encoding and decoding of policy uncertainty in the frontal cortex.

2014-2017

AWARDED TO ZACHARY MAINEN

- FELLOWSHIPS -

AUSTRIAN ACADEMY OF SCIENCE

DoC-fForte Fellowship

Understanding the function of Hypocretin/Orexin expressing neurons in neural circuits controlling locomotor behaviour of larval zebrafish

2012-2015

AWARDED TO SIMONE LACKNER

CONSELHO NACIONAL DE DESENVOLVIMENTO CIENTÍFICO E TECNOLÓGICO (CNPQ)

Postdoctoral Fellowship

Amplificação competitiva transitória em circuitos corticais

2014-2015

AWARDED TO NIVALDO VASCONCELOS

EUROPEAN MOLECULAR BIOLOGY ORGANISATION

Long-term Fellowship

Elucidating the molecular basis of food choice behaviour

2012-2014

AWARDED TO RICARDO GONÇALVES

Long-term Fellowship

Neural mechanisms underlying rapid modulation of spatial attention in the superior colliculus

2013-2015

AWARDED TO BASSAM ATALLAH

FULBRIGHT

Fulbright US Student Scholarship

Investigating the Role of Serotonin on Movement

2014-2015

AWARDED TO DHRUBA BANERJEE

FUNDACÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)

Postdoctoral Fellowship
2014-2017
AWARDED TO ALEJANDRO GOMEZ-MARIN

Postdoctoral Fellowship
2013-2015
AWARDED TO NICOLAS MORGENSTERN

Postdoctoral Fellowship
2013-2016
AWARDED TO ANA FERNANDES

Postdoctoral Fellowship
2012-2015
AWARDED TO CLAUDIA FEIERSTEIN

Postdoctoral Fellowship
2012-2015
AWARDED TO KENSAKU NOMOTO

Postdoctoral Fellowship
2012-2015
AWARDED TO MÁRCIA ARANHA

Postdoctoral Fellowship
2012-2015
AWARDED TO NÉLIA VARELA

Postdoctoral Fellowship
2012-2015
AWARDED TO PAVEL ITSKOV

Postdoctoral Fellowship
2012-2015
AWARDED TO ZITA SANTOS

PhD Fellowship (INDP 2013)
2014-2017
AWARDED TO ANNELENE DAHL

PhD Fellowship (INDP 2013)
2014-2017
AWARDED TO ANTONIA GRONEBERG

PhD Fellowship (INDP 2013)
2014-2017
AWARDED TO ANTÓNIO DIAS

PhD Fellowship (INDP 2013)
2014-2017
AWARDED TO CRISTINA FERREIRA

PhD Fellowship (INDP 2013)
2014-2017
AWARDED TO GABRIELA FIOREZE

PhD Fellowship (INDP 2013)
2014-2017
AWARDED TO JOVIN JACOBS

PhD Fellowship (INDP 2013)
2014-2017
AWARDED TO LORENZA CALCATERRA

PhD Fellowship (INDP 2013)
2014-2017
AWARDED TO MADALENA FONSECA

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO ASMA MOTIWALA

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO DANBEE KIM

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO HEDI YOUNG

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO MARINA FRIDMAN

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO MERT ERGINKAYA

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO MICHAEL PEREIRA

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO NUNO CALAIM

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO NUNO LOUREIRO

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO RAPHAEL STEINFELD

PhD Fellowship (INDP 2012)
2013-2016
AWARDED TO RITA FÉLIX

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO JACQUES BOURG

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO JOÃO AFONSO

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO JENS BIERFELD

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO JOAQUIM JACOB

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO LUÍS MOREIRA

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO RICARDO SILVA ZACARIAS

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO ROBERTO MEDINA

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO SILVANA ARAÚJO

PhD Fellowship (INDP 2011)
2012-2015
AWARDED TO SOFIA SOARES

PhD Fellowship (INDP 2010)
2011-2014
AWARDED TO GONÇALO LOPES

PhD Fellowship (INDP 2010)
2011-2014
AWARDED TO GUSTAVO MELLO

PhD Fellowship (INDP 2010)
2011-2014
AWARDED TO TIAGO MARQUES

PhD Fellowship (External PhD Student)
2011-2014
AWARDED TO PATRÍCIA RACHINAS-LOPES

PhD Fellowship (External PhD Student)
2012-2016
AWARDED TO SAMANTHA HERBERT

PhD Fellowship (External PhD Student)
2012-2015
AWARDED TO CATARINA ALBERGARIA

PhD Fellowship (External PhD Student)

2013-2017

AWARDED TO DANA DARMOHRAY

PhD Fellowship (External PhD Student)

2011-2015

AWARDED TO ANA CATARINA CASTRO

PhD Fellowship (External PhD Student)

2011-2015

AWARDED TO VICTORIA BRUGADA RAMENTOL

HUMAN FRONTIERS SCIENCE PROGRAM ORGANISATION (HFSPO)

HFSP Long-Term Fellowship

Serotonergic modulation of olfactory information processing

2011-2014

AWARDED TO ERAN LOTTEM

HFSP Long-Term Fellowship

Cell-type specific features of identified serotonergic neurons in the raphe nucle in behaving rats

2011-2014

AWARDED TO MAGOR LORINCZ

HFSP Long-Term Fellowship

Neural mechanisms underlying the encoding of contextual information in olfactory cortex

2012-2015

AWARDED TO CINDY POO

HFSP Long-Term Fellowship

Covariations between population neuronal activity and choice: a sensory or cognitive origin?

2012-2015

AWARDED TO JOSE LUIS PARDO-VAZQUEZ

NATIONAL SCIENCE FOUNDATION

Graduate Research Fellowship Program Fellowship

Dissecting Neural Variability Underlying Skill Learning with Brain-Machine Interfaces

2012-2015

AWARDED TO VIVEK ATHALYE

NORWEGIAN RESEARCH COUNCIL (RNC)

Postdoctoral Fellowship

Laminar segregation of top-down and bottom-up processes in primary auditory cortex.

2014-2017

AWARDED TO TOR STENSOLA

SWISS NATIONAL SCIENCE FOUNDATION

Early Post-doc Mobility Fellowship
Dissecting specific amygdala-striatal circuitries on exploration
2015-2016 (officially announced in 2014)
AWARDED TO PAOLO BOTTA

WELLCOME TRUST

Postdoctoral Fellowship
The neural basis of goal-directed behaviour
2011-2015
AWARDED TO THOMAS AKAM

CIÊNCIA VIVA

Escolher Ciência, Ciência Viva - National Agency for Scientific and Technologic Culture
2012-2014
AWARDED TO SCIENCECALIFRAGILISTIC TEAM

- AWARDS -

EUROPEAN MOLECULAR BIOLOGY ORGANISATION (EMBO)

Elected EMBO Member
Award Date: May 7, 2014.
AWARDED TO RUI COSTA

FEDERATION OF EUROPEAN NEUROSCIENCE SOCIETIES (FENS) & KAVLI FOUNDATION

Elected FENS-Kavli Scholar
2014-2018
AWARDED TO CARLOS RIBEIRO

LOUIS-JEANTET FOUNDATION

Louis-Jeantet Young Investigator Career Award
2014-2015
AWARDED TO RUI COSTA

REPUBLIC OF PORTUGAL

Honorific order of Portugal – Antiga, Nobilíssima
e Esclarecida Ordem Militar de Sant'Iago da Espada,
do Mérito Científico, Literário e Artístico.

Award Date: June 10, 2014.

AWARDED TO RUI COSTA

DEPARTMENT OF ARTIFICIAL INTELLIGENCE (UPM). MADRID, SPAIN.

Premio José Cuena

AWARDED TO FRANCISCO ROMERO

THE BRAIN CONFERENCES: CONTROLLING NEURONS, CIRCUITS AND BEHAVIOUR. APRIL 2014 RUNGSTEDGAARD, COPENHAGEN, DENMARK.

Best Poster Award

Rats cooperate in the absence of direct benefit: Developement of a new behavioural task.

AWARDED TO CRISTINA MARQUEZ

THE 22ND SCIENTIFIC MEETING OF THE INTERNATIONAL SOCIETY FOR MAGNETIC RESONANCE IN MEDICINE, MILAN, ITALY, MAY 10TH-16TH 2014

FOUR SEPARATE AWARDS AWARDED TO NOAM SHEMESH:

International Society of Magnetic Resonance in Medicine Summa cum Laude Merit Award for the paper: "Metabolic confinements in normal and stroked CNS in-vivo revealed by localized double-Pulsed-Field-Gradient MRS at 21.1."

International Society of Magnetic Resonance in Medicine Diffusion Study Group Award for the paper: "Metabolic confinements in normal and stroked CNS in-vivo revealed by localized double-Pulsed-Field-Gradient MRS at 21.1."

International Society of Magnetic Resonance in Medicine Summa cum Laude Merit Award for the paper: "Cellular size distributions revealed by Non-uniform Oscillating-Gradient Spin-Echo (NOGSE)-MRI."

International Society of Magnetic Resonance in Medicine Summa cum Laude Merit Award for the paper: "The internal gradient distribution tensor as a new source for orientation contrast in the CNS."

PUBLICA-
TIONS

ADVANCING SCIENTIFIC KNOWLEDGE

WHILE ADVANCING THE SCIENTIFIC PROCESS ITSELF

In 2014, work from the CNP resulted in 31 refereed-research-articles. Many of these articles were published in high impact journals, such as *Nature Neuroscience*, *Current Biology* and *Neuron*, mirroring the significant potential reach of the research done by CNP investigators.

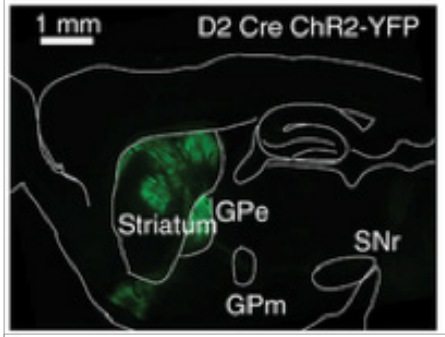
31

refereed-research-articles

How does the brain create sequences?

This study described the neural mechanisms by which the brain creates unique meaningful sequences out of single elements. A process that occurs when a set of isolated syllables become a word, or single notes become a musical piece. In this study, researchers at the Neurobiology found that neurons in a brain region called the Basal Ganglia also change their activity pattern from responses to single elements when learning begins, to responses to the entire sequence as learning progresses.

Jin X, Tecuapetla F, Costa RM. (2014). *Basal ganglia subcircuits distinctively encode the parsing and concatenation of action sequences.* Nature Neuroscience. 17(3):423-30.

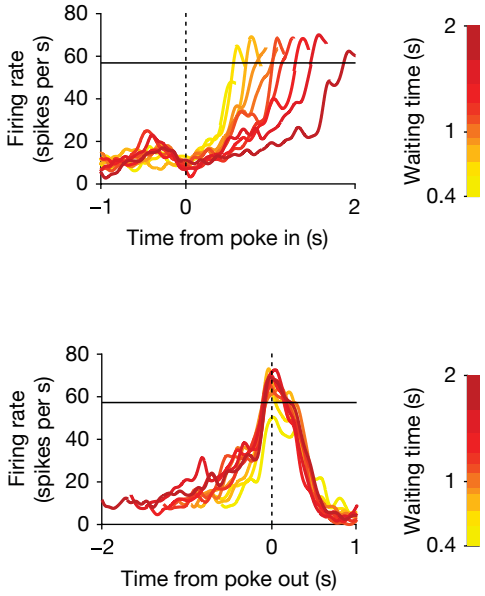


- PUBLICATION HIGHLIGHTS -

Using the brain to forecast decisions - Room for free will after all?

Is a study by the Systems Neuroscience Lab, the researchers discovered neurons that predict the timing of spontaneous actions in rats. In addition, they found that their data could be explained by a theory of decision-making called "integration-to-bound" model, a theory that suggests that even though some neurons appear to predict decisions, it is actually the wavering tally of the votes of multiple neurons that determine the final action of the individual.

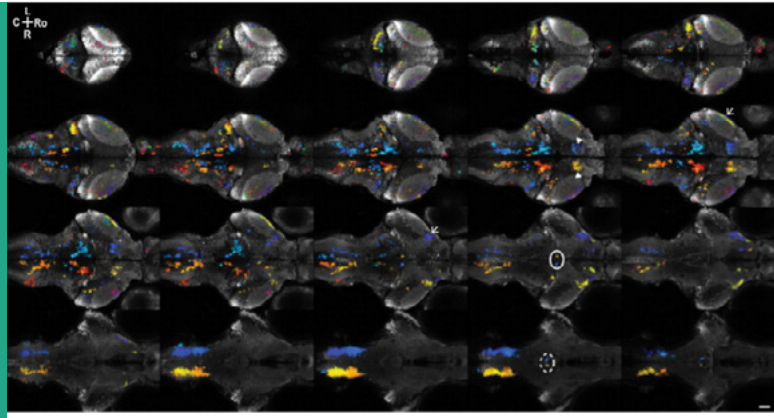
Murakami M, Vicente MI, Costa GM, Mainen ZF. (2014). *Neural antecedents of self-initiated actions in secondary motor cortex.* **Nature Neuroscience. 17(11):1574-82.**



First maps of neural activity in behaving zebrafish

A study published by the Vision to Action lab demonstrated the first maps of neural activity in behaving zebrafish. This study used advanced optogenetic tools to measure the activity of single cells throughout the entire brain of behaving zebrafish revealing new insights onto the neural circuits that mediate visual-motor coordination.

Portugues R, Feierstein CE, Engert F, Orger MB. (2014). *Whole-Brain Activity Maps Reveal Stereotyped, Distributed Networks for Visuomotor Behavior.* Neuron. 81(6):1328-43.

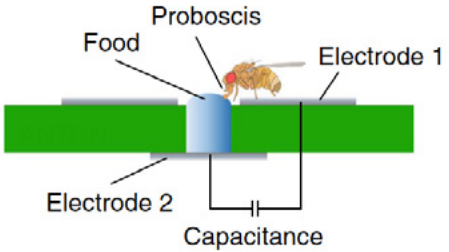


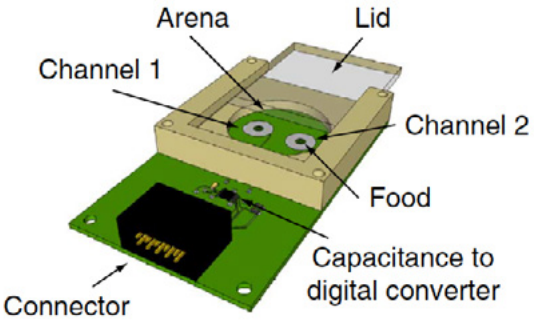
- PUBLICATION HIGHLIGHTS -

Fruit flies going high-tech: or how touchscreen technology helps to understand eating habits.

Using the same technology used in touch-screens, researchers from the lab of Behaviour and Metabolism illustrate an ingenious way to measure the miniscule amounts consumed by the fruit fly, thereby solving a long-standing problem in feeding research.

Itskov PM, Moreira JM, Vinnik E, Lopes G, Safarik S, Dickinson MH & Ribeiro C. (2014). *Automated monitoring and quantitative analysis of feeding behaviour in Drosophila.*
Nature Communication. 5: 4560.





- LIST OF PUBLICATIONS -

PEER-REVIEWED RESEARCH ARTICLES:

Almeida-Filho D., Lopes-Dos-Santos V, Vasconcelos NA, Miranda JG, Tort AB, Ribeiro S (2014). *An investigation of Hebbian phase sequences as assembly graphs.* **Frontiers. 8: 34.**

Álvarez GA, Shemesh N, Frydman L. (2014). *Diffusion-assisted selective dynamical recoupling: A new approach to measure background gradients in magnetic resonance.*
The Journal of Chemical Physics. 084205 (140): 1-9.

Cui G, Jun SB, Jin X, Luo G, Pham MD, Lovinger DM, Vogel SS, Costa RM (2014). *Deep brain optical measurements of cell type–specific neural activity in behaving mice.*
Nature Protocols. 6 (9): 1213-28.

Dell A, Bender JA, Branson K, Couzin ID, de Polavieja GG, Noldus LPJJ, Pérez-Escudero A, Perona P, Straw AD, Wikelski M, Brose U. (2014). *Automated image-based tracking and its application in ecology.* **Trends in Ecology & Evolution. 7 (29): 417–428.**

Dugué GP, Lörincz ML, Lottem E, Audero E, Matias S, Correia PA, Léna C, Mainen ZF. (2014). *Optogenetic recruitment of dorsal raphe serotonergic neurons acutely decreases mechanosensory responsivity in behaving mice.* **PloS One. 9(8):e105941.**

Gomez-Marin A, Louis M (2014). *Multilevel control of run orientation in Drosophila larval chemotaxis.*
Frontiers in Behavioural Neuroscience. 8:38.

Gonçalves PJ, Arrenberg AB, Hablitzel B, Baier H, Machens CK (2014). *Optogenetic perturbations reveal the dynamics of an oculomotor integrator.* **Frontiers in Neural Circuits. 8: 10.**

Gouvêa TS, Monteiro T, Soares S, Atallah Bassam V, Paton Joseph J. (2014). *Ongoing behaviour predicts perceptual report of interval duration.* **Frontiers in Neurorobotics. 8: 10.**

Itskov PM, Moreira JM, Vinnik E, Lopes G, Safarik S, Dickinson MH, Ribeiro C. (2014). *Automated monitoring and quantitative analysis of feeding behaviour in Drosophila.*
Nature Communications. (5): 4560.

Jin X, Tecuapetla F, Costa RM. (2014). *Basal ganglia subcircuits distinctively encode the parsing and concatenation of action sequences.* **Nature Neuroscience. 17: 423–430.**

Lak A, Costa GM, Romberg E, Koulakov AA, Mainen ZF, Kepecs A. (2014). *Orbitofrontal Cortex Is Required for Optimal Waiting Based on Decision Confidence.* **Neuroan. 84 (1): 190-201.**

Marques JC, Oh IK, Ly DC, Lamosa P, Ventura MR, Miller ST, Xavier KB (2014). *LsrF, a coenzyme A-dependent thiolase, catalyzes the terminal step in processing the quorum sensing signal autoinducer-2.* **Proceedings of the National Academy of Sciences of the United States of America. 39 (111): 14235-14240.**

Monteiro J, Aires R, Becker JD, Jacinto A, Certal AC, Rodríguez-León J. (2014). *V-ATPase Proton Pumping Activity Is Required for Adult Zebrafish Appendage Regeneration.* **PloS One. 9(3):e92594**

Murakami M, Vicente MI, Costa GM, Mainen ZF. (2014). *Neural antecedents of self-initiated actions in secondary motor cortex.* **Nature Neuroscience. 17(11):1574-82.**

Öst A, Lempradl A, Casas E, Weigert M, Tiko T, Deniz M, Pantano L, Boenisch U, Itskov PM, Stoeckius M, Ruf M, Rajewsky N, Reuter G, Iovino N, Ribeiro C, Alenius M, Heyne S, Vavouri T, Pospisilik JA. (2014). *Paternal diet defines offspring chromatin state and intergenerational obesity.* **Cell. 159(6):1352-64.**

Pérez-Escudero A, Vicente-Page J, Hinz RC, Arganda S, de Polavieja GG. (2014). *idTracker: tracking individuals in a group by automatic identification of unmarked animals.* **Nature Methods. 7 (11): 743-8.**

Pessoa D, Souto-Maior C, Gjini E, Lopes JS, Ceña B, Codeço CT, Gomes MG (2014). *Unveiling Time in Dose-Response Models to Infer Host Susceptibility to Pathogens.* **PLoS Computational Biology. 10(8):e1003773.**

Portugues R, Feierstein CE, Engert F, Orger MB (2014). *Whole-Brain Activity Maps Reveal Stereotyped, Distributed Networks for Visuomotor Behaviour.* **Neuron. 6 (81): 1328-1343.**

Raposo D, Kaufman MT, Churchland AK (2014). *A category-free neural population supports evolving demands during decision-making.* **Nature Neuroscience. 17(12):1784-92.**

Rivera-Alba M, Peng H, de Polavieja GG, Chklovskii DB. (2014). *Wiring economy can account for cell body placement across species and brain areas.* **Current Biology. 24(3):R109-10.**

Schreiweis C, Bornschein U, Burguière E, Kerimoglu C, Schreiter S, Dannemann M, Goyal S, Rea E, French CA, Puliyadi R, Groszer M, Fisher SE, Mundry R, Winter C, Hevers W, Pääbo S, Enard W, Graybiel AM (2014). *Humanized Foxp2 accelerates learning by enhancing transitions from declarative to procedural performance.* **Proceedings of the National Academy of Sciences of the United States of America. 39 (111): 14253-14258.**

Severi KE, Portugues R, Marques JC, O'Malley DM, Orger MB, Engert F. (2014). Neural Control and Modulation of Swimming Speed in the Larval Zebrafish. Neuron. 2 (83): 00578-9.

Semedo J, Zandvakili A, Kohn A, Machens CK*, Yu B*. (2014). *Extracting Latent Structure From Multiple Interacting Neural Populations.* **Advances in Neural Information Processing 27.**

Shemesh N, Rosenberg JT, Dumez JN, Grant SC, Frydman L. (2014). *Metabolic T1 dynamics and longitudinal relaxation enhancement in vivo at ultrahigh magnetic fields on ischemia.* **Journal of Cerebral Blood Flow & Metabolism. 34(11):1810-7.**

Shemesh N, Rosenberg JT, Dumez JN, Muniz JA, Grant SC, Frydman L. (2014). *Metabolic properties in stroked rats revealed by relaxation-enhanced magnetic resonance spectroscopy at ultrahigh fields.* **Nature Communications. 5:4958.**

Siegle JH, Pritchett DL, Moore CI. (2014). *Gamma-range synchronization of fast-spiking interneurons can enhance detection of tactile stimuli.*
Nature Neuroscience. 17: 1371–1379.

Tecuapetla F, Matias S, Dugue GP, Mainen ZF, Costa RM. (2014). *Balanced activity in basal ganglia projection pathways is critical for contraversive movements.* Nature Communications. 5: 4315.

Vasconcelos M, Monteiro T (2014). *European starlings unriddle the ambiguous-cue problem.* Frontiers in Psychology. 5:944

Vertechi P*, Brendel W*, Machens CK. (2014). *Unsupervised learning of an efficient short-term memory network.*
Advances in Neural Information Processing 27.

Xue M, Atallah BV, Scanziani M. (2014). *Equalizing excitation–inhibition ratios across visual cortical neurons.*
Nature. 511, 596–600.

REVIEW ARTICLES

Akam T. & Kullmann DM. (2014). *Oscillatory Multiplexing of Population Codes for Selective Communication in the Mammalian Brain.* Nature Reviews Neuroscience. 5: 111–122 .

French CA, Fisher SE (2014). *What can mice tell us about Foxp2 function?* Current Opinion in Neurobiology. C (28): 72-79.

Gomez-Marin A, Paton JJ, Kampff AR, Costa RM, Mainen ZF. (2014). *Big behavioural data: psychology, ethology and the foundations of neuroscience.*
Nature Neuroscience. 17: 1455–1462.

Grant RA, Itskov PM, Towal RB, Prescott TJ (2014). *Active touch sensing: finger tips, whiskers, and antennae.*
Frontiers in Behavioural Neuroscience. 8: 50.

Lima B, Cardoso MM, Sirotin YB, Das A (2014). *Stimulus-Related Neuroimaging in Task-Engaged Subjects Is Best Predicted by Concurrent Spiking.*
The Journal of Neuroscience. 42 (34): 13878-13891.

Ramiro-Cortés, Y, Hobbiss, AF, Israely I (2014). *Synaptic competition in structural plasticity and cognitive function.* Philosophical Transactions of the Royal Society Lond B: Biological Sciences. 369(1633):20130157.

Renart A, Machens CK (2014). *Variability in neural activity and behaviour.* Current Opinion in Neurobiology. (25): 211-220.

Uchida N, Poo C, Haddad R. (2014). *Coding and Transformations in the Olfactory System.* Annual Review of Neuroscience. 37: 363–85.

COMMENTS

Akam T, Costa RM (2014). *When brains flip coins.* **Neuron. 1 (84): 9-11.**

Albergaria C, Carey MR (2014). *Neural circuits: All Purkinje cells are not created equal.* **eLife Sciences. 3:e03285.**

Atallah BV, Scanziani M, Carandini M. (2014). *Interneuron subtypes and orientation tuning (Reply).* **Nature. 508**

Dewitt EE. (2014). *Neuroeconomics: A Formal Test of Dopamine's Role in Reinforcement Learning.* **Current Biology. 24 (8): R321–R32.**

Herbert SL, Ribeiro C. (2014). *Nutrition: Rejection Is the Fly's Protection.* **Current Biology. 24(7):R278-80.**

Mainen ZF, Pouget A. (2014). *European Commission: Put brain project back on course.* **Nature. 534: 511.**

Pritchett DL, Carey MR (2014). *A matter of trial and error for motor learning.* **Trends in Neurosciences. 9 (37): 465–466.**

Renart A. (2014). *Bringing the Dynamics of Movement under Control.* **Neuron. 6 (82): 1193-5.**

Sumbre G, de Polavieja GG. (2014). *The world according to zebrafish: how neural circuits generate behaviour.* **Frontiers in Neural Circuits. 8:91.**

BOOK CHAPTERS

Leitão-Gonçalves, R, Ribeiro C. (2014) *Using neuron specific RNAi in Drosophila for understanding the molecular and neuronal basis of behaviour.* In: **Handbook of Behavioural Genetics of *Drosophila melanogaster* ed. Dubnau, J., Cambridge University Press, UK.**

Kepecs A, Mainen ZF (2014) *A Computational Framework for the Study of Confidence Across Species.* In: **The Cognitive Neuroscience of Metacognition (pp. 115-145). Springer Berlin Heidelberg.**

SUPPORT

TO HELP OUR SCIENTISTS

REACH THEIR FULL CREATIVE POTENTIAL

CNP ADMINISTRATIVE UNIT

The CNP Administrative Unit is responsible for providing comprehensive administrative services, including budget and financial management; purchasing, procurement, human resources services and science communication.

The vision of the Administrative Unit is to be an exemplary resource in the field of research administration by providing management tools, educational opportunities and exceptional service. We strive to support the CNP research community by addressing any question or concern and by maximising the time spent in research.

The members of the CNP Administrative Unit function as a dynamic and multidisciplinary team and affirm their contribution to research advancement.

PHILIPP TSOLAKIS
GROUP HEAD

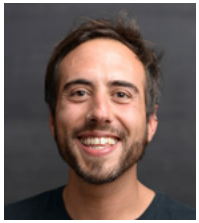
Philipp Tsolakis
Group Head; Financial Manager / Controller

Raquel Gonçalves
Purchasing and Ordering

Tânia Li Chen
Teaching Lab Manager

Shira Lottem
Admin Data Architect

João Cruz
Lab Administrator



Bruno Ceña
Lab Administrator

Francisco Semedo
Lab Administrator

Alexandra Piedade
Human Resources, INDP Assistant

Teresa Carona
Human Resources, INDP Assistant

ADMINISTRATIVE OFFICE

The Administrative Office provides all necessary aid, in all the fields from social, bureaucratic and practical, in order to ease the integration of new members and to provide all the necessary tools for the researchers to fully perform their priority goal – scientific research.

Inês Soeiro
Assistant to the Directors

ASSISTANT TO THE DIRECTORS

The position of Assistant to the Directors provides senior-level executive support to the Scientific Directors of the CNP by providing administrative assistance to their daily activities oand by managing their agendas and scheduling.

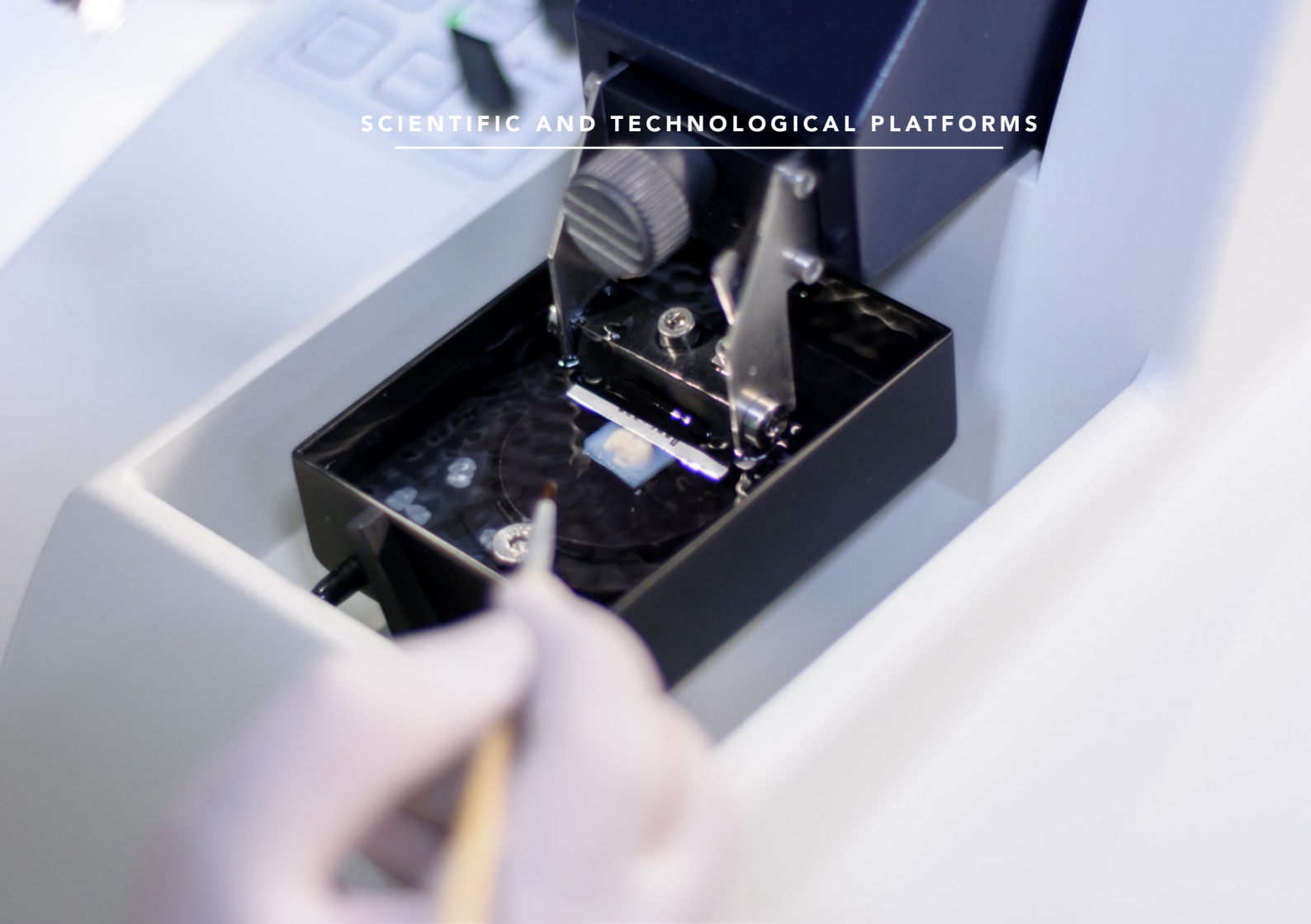
Catarina Ramos
Group Head

Liad Hollender
Science Communication

SCIENCE COMMUNICATION OFFICE

This office coordinates science communication initiatives that range from science education and outreach to the organisation of scientific meetings. In parallel, our team is also responsible for broadcasting CNP News by maintaining online presence and facilitating communication with the Media.

SCIENTIFIC AND TECHNOLOGICAL PLATFORMS



The Champalimaud Scientific & Technological Platforms are shared facilities that host technical and scientific infrastructures essential for research development at the Champalimaud Centre for the Unknown.

The mission of the Platforms is to provide word-class scientific services to investigators, focusing on the development and optimisation of critical research tools. Each platform provides a comprehensive set of major equipment required to conduct customary operations, as well as expertise from experienced personnel that consult on experimental design and perform both routine and complex technical procedures, allowing for high quality, standardised and reproducible results across different experimental projects.

In 2014, the Platforms have seen a new increase in equipment usage as well as in the demand for Platforms' services by researchers and clinicians, reflecting the continued confidence in the support services provided to the community.

TÂNIA VINAGRE
DIRECTOR

PLATFORM MEMBERS

Maria José Vito
Glasswash and Media Preparation Platform

Patrick Teca
Glasswash and Media Preparation Platform

Soraia Rodrigues
Glasswash and Media Preparation Platform

Madalena Martins
Glasswash and Media Preparation Platform

José Rino
Optical Imaging & Microscopy

Sérgio Casimiro
Histopathology

Susana Dias
Histopathology

Isabel Campos
Fly Platform

Liliana Costa
Fly Platform

Susana Dias
Fly Platform

João Pereira
Vivarium

Ana Mourão
Vivarium

Wilma Zovo
Vivarium

Ana Catarina Certal
Fish Platform

Sandra Martins
Fish Platform

Ana Cunha
Molecular Biology

Ricardo Ribeiro
Scientific Software

Pedro Carvalho
Scientific Software

Ana Santos
Histopathology

Leo Madruga
Histopathology

Rubina Caldeira
Vivarium

Joana Almeida
Vivarium

Matheus Silva
Vivarium

Rita Alho
Vivarium

Claudio Macedo
Vivarium

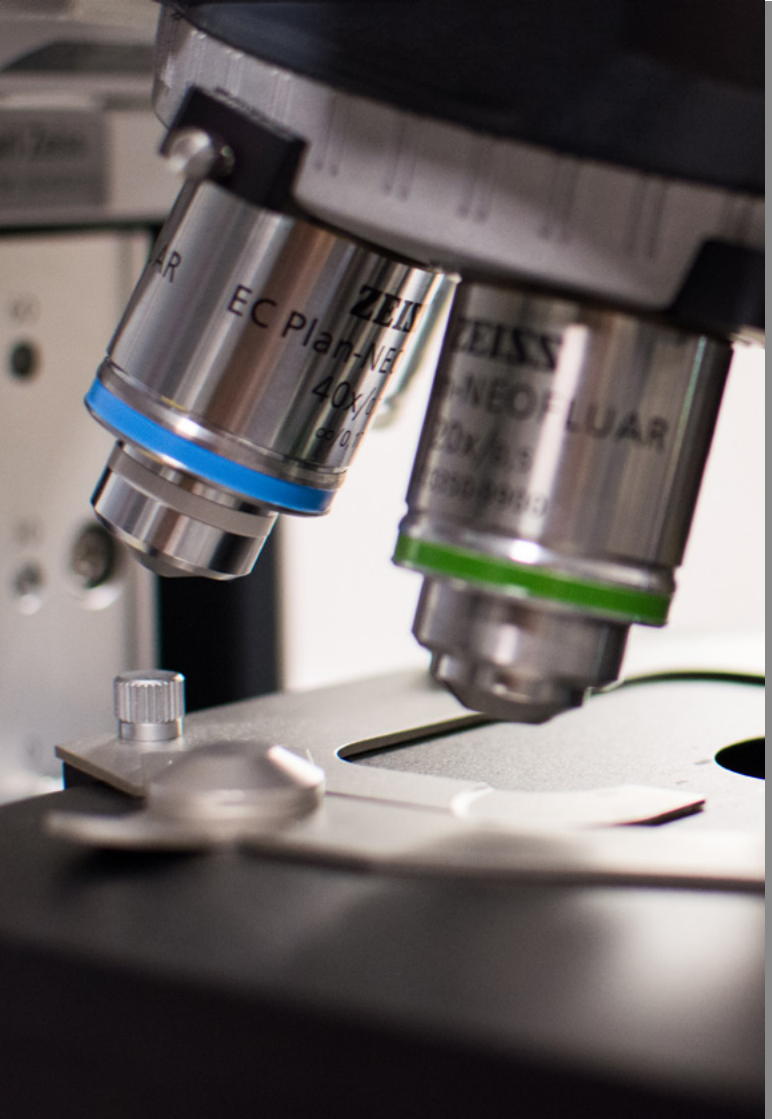
Ana Franco
Fish Platform

Filipe Carvalho
Scientific Hardware Platform

Artur Silva
Scientific Hardware Platform

GLASS WASH AND MEDIA PREPARATION PLATFORM (GWMPP)

The Glass Wash and Media Preparation Platform has inaugurated the new centralised sterilisation service to support the clinical area, a new challenge requiring rigorous standard operating procedures, personnel training, and operational circuits. To support these activities as well as the growth of the research workload, the GWMPP's team has expanded to include 2 new technicians and 1 operational assistant.



OPTICAL IMAGING AND MICROSCOPY PLATFORM (OIMP)

The Optical imaging and Microscopy Platform (OIMP) trained 34 new users in 2014 in different microscopy systems totalling 42 training sessions. In 2014, 62 investigators from 18 different groups - ranging from research laboratories, to clinical groups and Platforms - used platform's services, totalling 2.648 hours of microscopy usage. The OIMP has been included in the Portuguese Bioimaging Platform (PPBI), a national consortium with 17 imaging and microscopy nodes, which includes over 100 state-of-the-art microscopy instruments and 1.400 registered users. This infrastructure is included in the FCT's 2014-2010 National Roadmap for Research Infrastructures with Strategic Interest.

THE HISTOPATHOLOGY PLATFORM (HP)

The Histopathology Platform (HP) provided services to 10 research groups of the Champalimaud Neuroscience Programme as well as to 1 Platform. In 2014 511 samples were processed, of which 366 resulted in 3832 histological slides and the remaining were delivered in plates for further analysis by the researchers. Histochemistry and Immunohistochemistry services were provided, and the latter serviced increased in amount of requests compared to the previous year. Furthermore, the HP team was strengthened with the recruitment of 2 new technicians.

THE MOLECULAR BIOLOGY PLATFORM (MBP)

The Molecular Biology Platform (MBP) produced in 2014 13 AVV batches of 4 different serotypes and cloned 18 recombinant DNA constructs. The MBP also isolated DNA from patient samples in collaboration with clinical groups at CF. Furthermore; in 2014 the Platform added a Western-Blot analysis equipment to its inventory and prepared a market analysis for setting up a potential genotyping facility and services for the researchers.

SCIENTIFIC SOFTWARE DEVELOPMENT PLATFORM (SDP)

The Scientific Software Development Platform (SDP) continued to support research groups by providing customised software tools for video analysis and automatic tracking of animal behaviour. Furthermore, in 2014 the SDP developed the "OpenCSP" web portal which compiles and a variety of applications and computational equipment in order to facilitate the sharing of software tools among the different research groups. In the scope of this last project, the Platform collaborated with the Laboratory of Instrumentation and Experimental Particles Physics to use the available computational resources at a national level.

VIVARIUM

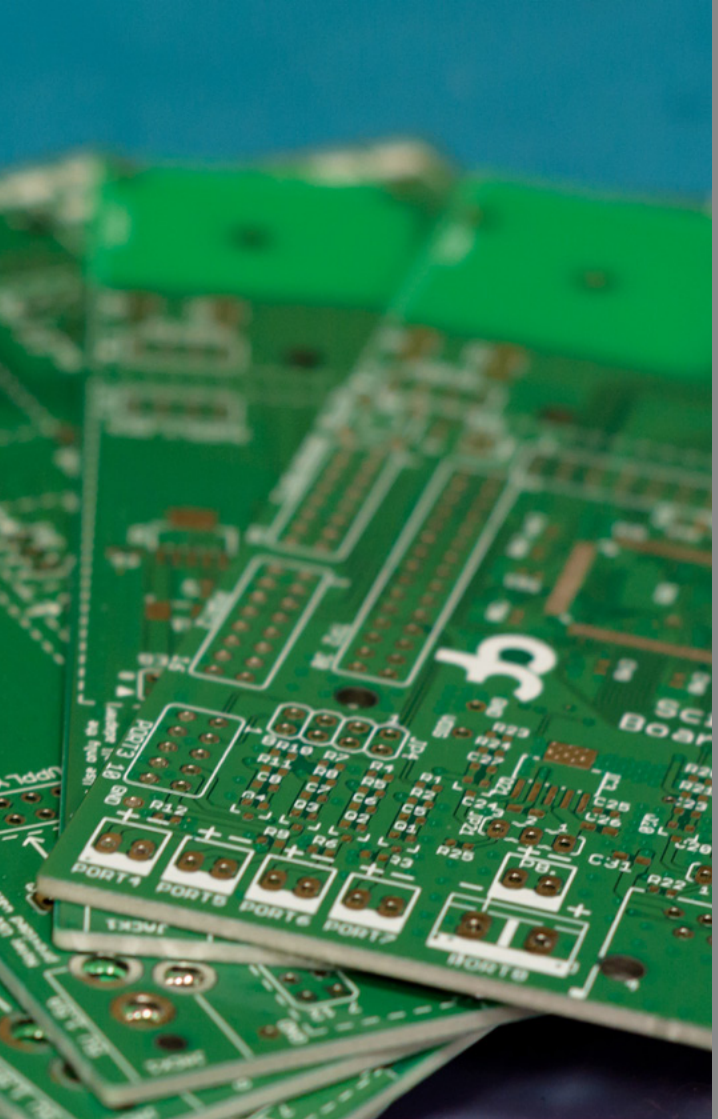
The Vivarium increased the number of housing and experimental rooms, all with improved the experimental conditions. The vivarium implemented a number of welfare and operational policies and by the end of 2014, established the ORBEA (orgão regulador do bem-estar animal), the animal welfare body in agreement with the national and international directives. The vivarium team strives to be updated to the latest technological developments. To that purpose, several team members participated in meeting and training courses.

FLY PLATFORM

The Fly Platform expanded its operations in 2014 and grew its team accordingly. In 2014, the Fly Platform served over 20 internal users from 4 different research groups, as well as several dozens external users from 13 external research labs from 2 different institutions (IGC - Instituto Gulbenkian de Ciência e CEDOC – Centro de Estudos em Doenças Crónicas). In 2014 the Platform integrated the Consortium for Genetically Tractable Organisms (CONGENTO) included in the FCT's 2014-2010 National Roadmap for Research Infrastructures with Strategic Interest, in which the Fly Platform is the coordinator for the *Drosophila* model.

FISH PLATFORM

The Fish Platform expanded its operations during 2014, with the addition of 2 new research groups as main users of its facilities and services, totalling 16 users from 3 different groups. Accordingly, the Fish Platform's team grew to include one additional technician. In 2014, the Platform provided 4.000 fish crosses, maintained over 30 Zebrafish lines, incubated over 400 lines and exported 12 strains. The Platform maintained a medium-scale production of live feed, including artemia and rotifers. Together with 3 other facilities worldwide, the Fish Platform implemented a new database for Zebrafish facilities that will be used as a management tool for both the researchers and the Platform staff. Finally, the Fish Platform integrated the Consortium for Genetically Tractable Organisms (CONGENTO) included in the FCT's 2014-2020 National Roadmap for Research Infrastructures with Strategic Interest as the coordinator for the Zebrafish model.



SCIENTIFIC HARDWARE PLATFORM

The goal of the Scientific Hardware Development Platform is to provide all kind of support in the electronic hardware field to support research at the individual, group and program levels to improve the ability of investigators to focus on their research subjects. The platform can provide the users with all kind of services ranging from support, training, use of specific equipment, to full design of any analog or digital simple or complex function. The platform means encompass standard CAD tools, PTH or SMD assembly equipment and debug and test equipment.

OFFICE FOR SPONSORED PROGRAMMES

The mission of the Office for Sponsored Programmes (OSP) is to provide excellent support to investigators in pre-award and post-award matters. This includes the identification of funding opportunities, the administration of applications, as well as the financial management and reporting of awards and grants.

OSP team members strive to be active problem solvers rather than passive receiving and reporting agents. The ultimate goal of the OSP is to become a platform of reliability and professionalism that improves the overall success rates of securing competitive external funding and contributes to a productive scientific environment by allowing investigators to focus on their research.

Joaquim Cabral-Teixeira
Office for Sponsored Programmes

Agnes Lopes
Office for Sponsored Programmes

Inês Matias
Office for Sponsored Programmes

Pedro Monteiro
Office for Sponsored Programmes

Rafaela Costa
Office for Sponsored Programmes

Inês Bonifácio
Office for Sponsored Programmes

OUTREACH

TO SHARE OUR KNOWLEDGE

NOT ONLY WITH THE SCIENTIFIC COMMUNITY
BUT WITH THE COMMUNITY AT LARGE

SCIENCE COMMUNICATION OFFICE

photo by: Manuel Moreira

To secure the support of the public to pursue long-term benefits for humankind, science must effectively communicate to society and engage the public in its discoveries and breakthroughs. A leading scientific institution should not only produce the best quality research but also actively work to share the wonders of its research in a manner accessible to the larger community.

The Science Communication Office coordinates outreach and communication activities. The initiatives of the office range from science education and outreach, to the organisation of scientific meetings. In parallel, our team is also responsible for broadcasting CNP News by maintaining online presence and facilitating communication with the Media.

CATARINA RAMOS
Group Head

LIAD HOLLENDER
Science Communication

PRESS OFFICE

The CNP Science Communication Office also manages requests from the Media and issues press releases regularly. In 2014, 22 press releases were produced, resulting in 381 mentions in the local Portuguese Media. In addition, the Office mediated requests from the media, including requests for interviews of CNP faculty in various Portuguese newspapers; and magazines such as Observador, Diário de Notícias and Máxima, television channels such as RTP and SIC; and radio stations such as Antena 1. In addition to these, CNP research was also broadcasted internationally, both in response to press releases and by specific requests, namely by The Scientist Magazine, Scientific American and the Spanish TV channel TVE.

CNP investigators provided interviews on their work and their lives as scientists on over 20 different occasions, thus communicating information about the work done at the CNP and on current important topics in neuroscience research to the general public.

ONLINE PRESENCE

(WEBSITE, SOCIAL MEDIA AND NEWSLETTERS)

Updates on scientific events and news are sent out to the CNP community on a weekly basis in the form of a weekly newsletter and following reminders. In addition, regular website updates of news and events are posted by the Science Communication Office. In 2014, 44 individual news posts were published on the CNP website, with corresponding updates on the CNP Facebook page.

In 2014, besides an improvement in both the content and the look of the CNP internal newsletter, a new external newsletter was launched. Through the CNP website, people interested in receiving monthly CNP news and information about upcoming events can register to receive this newsletter.

Since late 2014, CNP is also present on Twitter with a new account (@Neuro_CF) where followers are informed about CNP-organised courses, symposia, public events and achievements.

SCIENCECALIFRAGILISTIC

INSTRUCTORS: Catarina Ramos, Pedro Ferreira, Ana Pereira, Ana Mafalda Vicente, Maria Inês Vicente, Rodrigo Abreu, Teresa Carlos and Tânia Li Chen.

Sciencecalifragilistic is a science education project funded by Ciência Viva. It was launched in 2013 by a group of PhD students and Postdoctoral researchers from the CNP. The purpose of the project was to stimulate scientific reasoning, critical thinking and creativity among the non-scientific community, particularly at the high-school level. Towards this end, high school students were guided through the different steps of the scientific method, from the formulation of a question, or generation of a hypothesis, to the resolution of a problem. Along the way students collect, analysed and discussed scientific data in a laboratory environment at CCU.

Students and tutors were distributed in three experimental projects, which were developed in the Teaching Lab at the CCU. The students were exposed to the way knowledge is built, by trial and error and consecutive iterations and experiments, where hypotheses and results are constantly evaluated and discussed. Moreover, the students were challenged to communicate their work through the preparation of lab meetings and debates.

This project was planned for two consecutive years (2012/2013 and 2013/2014), each cycle lasting six months. The second cycle started in January 2014 with an Opening Session for 200 teachers and students and was completed in May 2014 with the 2nd Sciencecalifragilistic Symposium, where students presented their scientific projects and main findings to their colleagues, teachers and families. Twelve students were selected to the project, based on their motivation letters: two 12th grade students from Escola Secundária de Camões, two 11th grade from Escola Secundária Francisco Simões, three 11th grade students from Escola Secundária da Portela and three 10th grade students


AR-RESPIRE CONNOSCO

Drawing on the enthusiasm of the Champalimaud Neuroscience Programme community and spearheaded by students, a series of science communication events called Ar was established. Ar is Portuguese for air, representing how pervasive and fundamental science is in our daily lives.

Ar events explore fundamental scientific themes by intertwining work from leading thinkers, both local and international. On each event scientists and non-scientist, such as chefs, dancers, group facilitators, economists and others, engage the public to think, interact and debate their ideas. Presentations are entertaining and dynamic and include cutting edge interactive games and open discussion. In 2014, two Ar events and three SeminAr events (a spinoff and shorter version of the Ar events) took place at the Champalimaud Auditorium.

In addition, in 2014 Ar organised it's first 3-part programme of events, dedicated to Dance. The programme included 3 full events and a series of workshops that took place at various spaces around the CCU.

In 2014, Ar also co-organised, together with the Commission for the 40th Anniversary of the Carnation Revolution and the Portuguese Government, a conference called "Deliberation Day" where, with the participation of insightful speakers and the audience participation, complex systems, collective and individual decision making, economics, and the exploding power of information technology were discussed.

Supporting the events, the same group of students has implemented a range of online resources, including streaming and hosted multimedia content, a webzine, a newsletter and social networking that links the actual events with a range of relevant established sources from scholarly blogs to TED talks and much more.

HOSTS AND ORGANISERS: Samuel Walker, Alex Gomez-Marin, Sara Matias, Rita Venturini, Gustavo Mello, Francisco Esteves, Marina Fridman, Nuno Loureiro, Anna Hobbiss, Tiago Marques, Gil Costa, Bruno Afonso, Eric Dewitt, Scott Rennie, Rita Venturini, André Mendonça and Catarina Ramos.

AR-RESPIRE CONNOSCO

LIST OF EVENTS 2014

Alternate Realities
How insects Perceive the World

SeminAr. January 31.

Speaker: Lars Chittka (Queen Mary, Univesity of London, UK).

MCs: Samuel Walker, Maria Inês Vicente, Liad Hollender. (All CNP).

Attributing Agency
Towards a Scientific Concept of Free Will

SeminAr. March 27.

Speaker: Björn Brembs (Regensburg University, Germany)

MCs: Alex Gomez-Marin. (CNP)

DançAr
Dancing In the Brain

Three-part programme, consisting of three separate full Ar events with associated workshops.

MCs: Gustavo Mello, Sara Matias, Rita Venturini (All CNP).

DançAr Event 1:

Diving Into Dance.

Ar Event. April 5.

Speakers: Megan Carey (CNP), Capoeira demonstrations, Guido Orgs (Brunel University, UK).

DançAr Event 2:

Dancing Your Words Away.

Ar Event. April 26.

Speakers: Nicky Clayton (Cambridge University; Clare College, UK), Clive Wilkins (Artist, UK).

DançAr Event 3:

Dismantling the Predictable.

Ar Event. May 7.

Speakers: Satu Palokangas (Moving On CentreSomatic Education


DANÇAR
design by gil costa
DANCING IN THE BRAIN
05.04 DIVING INTO DANCE
26.04 DANCING YOUR WORDS AWAY
07.05 DISMANTLING THE PREDICTABLE
21.00 CHAMPALIMAUD CENTRE FOR THE UNKNOWN AUDITORIUM AV. BRASÍLIA, DOCA DE PEDROUÇOS, LISBOA REGIS-
Champalimaud Foundation

& Process Arts, Germany), Rui Costa (CNP), Sten Rudstrom (Artist, Germany)

Visualising Complexity
Interactions of Art, Design and Science

SeminAr: May 29.

Speaker: Manuel Lima (Designer, USA)

MCs: Gil Costa, Liad Hollender (All CNP)

Mapping the Unknown
The Role of Big Ideas in Science

Ar Event: July 30.

Speakers: Zachary Mainen (CNP), Giacomo Rizzolatti (University of Parma, Italy), Po Shu Wang (Artist, USA), Alon Prohm (Artist, Germany)

MCs: Rita Venturini, Dhruba Banerjee (All CNP)

Dia da Deliberação | Deliberation Day

Ar Conference: October 25.

Speakers: Steve Keen (Kingston University, UK), Gonzalo de Polavieja (CNP), Darren Schreiber (University of Exeter, UK), André Freire (Lisbon University Institute, Portugal), Luis Rocha (Indiana University, USA).

MCs: Rui Costa, Scott Rennie, Anna Hobbiss, Catarina Ramos, Fransisco Esteves (All CNP).

The Path to Happiness
Peace or Pleasure?

Ar Event. December 4.

Speakers: Morten Kringelbach (Oxford University), Scott Rennie (CNP).

MCs: Nuno Loureiro, Marina Fridman (All CNP).


André Freire
Darren Schreiber
Gonzalo de P.
Rita Carvalho
Steve I
Luis Rocha

RAÍZES DA CURIOSIDADE | ROOTS OF CURIOSITY

Roots of Curiosity is an art-science project designed by three CNP researchers and developed through a partnership between the Centro Cultural de Belém (CCB) and the Champalimaud Foundation (CF).

This project began in January of 2012, with an Ar Event dedicated to creativity. For the three organisers of the event – Patrícia Correia, Ana Rita Fonseca and Samuel Viana – this was the first step in this journey. Soon after that Ar event, the CCB released a call for projects that addressed the connection between art and science and the three friends applied with a proposal that was accepted.

Over 2014, five pairs of artists and scientists were challenged to create an object that would be both artistic and scientific. For that, the three CNP organisers proposed the creation of a space and a time where the pairs could discover similarities and differences between their motivations and methodologies, thus enabling them to immerse in the creative world of symbiotic possibilities. Artists and scientists worked together for a year, through two residences, the first create the pairs and the second one for the pairs to present the resulting objects to the group.

Given the complexity of the project, the Roots of Curiosity turned into an art-science cycle where different formats were produced for different audiences. This cycle included: three days of performance, for young adults – Roots of Curiosity at the CCB; one month workshops for schools and families - Brain Tour Centreat the CCB; and the planning of a two day conference for adults scheduled for 2015 at the CF Auditorium. Future plans for this cycle also include a documentary about the whole process, which will be distributed together with a book written by all team members.

Curation:
MADALENA WALLENSTEIN

Original idea and Direction:
ANA RITA FONSECA, PATRÍCIA CORREIA, SAMUEL VIANA

Artistic Direction:
MARIA GIL

Neuroscientists: ALEX GOMEZ-MARÍN, ANA PEREIRA,
GIL COSTA, MARIA INÊS VICENTE, THIAGO GOUVÊA

Artists:
CATARINA VASCONCELOS (designer / vídeo performer),
FILIPE RAPOSO (composer / musician),
SARA ANJO (ballet dancer/ choreographer),
TERESA GENTIL (composer / musician),
TIAGO BARBOSA (actor)

Executive Production:
PRODUÇÕES INDEPENDENTES, TÂNIA M. GUERREIRO

Co-Production:
CENTRO CULTURAL DE BELÉM / FUNDAÇÃO CHAMPALIMAUD

photo by: Manuel Moreira

MONTHLY HIGH SCHOOL VISITS

Over 500 high school students visited the CCU in 2014, proving our Open Door Policy a worthwhile mission that will continue in 2015, with the aid of the recently launched online calendar for registrations.

Once a month, investigators from the CNP welcome a group of 50-60 students who arrive from all across Portugal. The investigators introduce the students to the world of neuroscience, talk to them about their research, their motivations and career paths. All visits end with a tour around the laboratories and facilities, like the fly room, where fruit fly stocks are kept and experiments with this invertebrate animal model are performed.

GUIDED TOURS: Maria Inês Vicente, Nivaldo Vasconcelos, Cristina Afonso, Pedro Ferreira, Isabel Campos, Catarina Ramos
INTRODUCTION: Maria João Villas-Boas
PRESENTERS: Marta Moita, Maria Luisa Vasconcelos and Susana Lima

SPORADIC INITIATIVES

THE SYMPOSIUM OF OCCAM'S BEARD
February 1

The Symposium of Occam's Beard was a celebration of creativity in science, though not necessarily in the way you would expect! At this symposium, scientists from varying backgrounds presented theories that are solidly scientific, except for one thing: they are nowhere near the 'simplest explanation' for the observations and data that they have.
Speakers:

- A. Márcia Barbosa (University of Évora), Thiago Carvalho (IGC), Mário Ferreira & Lorenzo Quaglietta et al. (IICT; CIBIO), David Marçal & Bruno Pinto (Cientistas de Pé),

- Alexandre Monteiro & Tânia Manuel Casimiro — *An experienced archaeological diver and nautical archaeology expert at ICOMOS (to name but a few of Alexandre's qualifications) and a postdoctoral researcher investigating the trade and consumption of Portuguese ceramics at IAP and IHC. Together they will take us to the depths of the Atlantic Ocean to find Atlantis... in the Açores.*

- Marta Isabel Pereira et al. — *A hematologist and two clinical pathologists, who will, at last, present the true story of how Eastern mysticism and astrology affect the epidemiology of Western bacterial nosocomial infections.*

- Mário Silva — *A science prodigy in the 11th grade of the Colégio Internato dos Carvalhos, presenting a revolutionary theory on the evolutionary origin of male pattern baldness.*

Organisers: Anna Hobbiss and Marina Fridman (CNP),
Barbara Vreede, Marc Gouw and Vânia Silva
(Instituto Gulbenkian de Ciência).

WITHOUT SCIENCE THE WORLD STOPS - FLASH MOB
February 15

On February 15th, a group of CNP investigators organised a flash mob called "Sem A Ciência o Mundo Pára" to call the attention of everyone who passed by Praça Luis de Camões in Lisbon, to the importance of investing in science. For three minutes people, scientists or non-scientist, working-colleagues, friends, or total strangers gathered to give science a face, to demonstrate that without science, the world would stop.

Organisers: Simone Lackner, Sara Matias, Roberto Medina,
Marta Camacho, Thiago Gouvêa, Eric DeWitt, Catarina Ramos

YEAR OF THE BRAIN
February 17

2014 was chosen to be the Year of the Brain in Europe, with the goal of communicating scientific concepts in neuroscience to the general public and increasing awareness to neural disorders and diseases. In Portugal, as part of this project, Ciência Viva has launched a video contest, recruiting CNP as one of its national scientific partners. 20 teachers were first invited for a workshop

"O cérebro de dentro para fora | The brain from the inside out" that took place at the CCU and then their students produced short videos that were evaluated by CNP researchers.

Organisers: Pedro Ferreira, Catarina Ramos, Rui Costa (all CNP)

BRAIN AWARENESS WEEK

March 8-15

The Brain Awareness Week (BAW) 2014 included initiatives where CNP researchers were invited to interact with teachers and students from all over Europe and had the opportunity to talk, discuss and answer questions related with the latest advances in neuroscience research, neuroenhancement, its ethical and social challenges.

BAW 2014 Opening Session

Faculdade de Ciências da Saúde, Universidade da Beira Interior, Covilhã
March 8

Talk: *"Como gerar novas ações"*
Round table: *"O desafio de contrariar o envelhecimento cerebral"*
Participant: Rui Costa (CNP)

inGenious Online Chat - European Schoolnet with Direção Geral da Educação

Champalimaud Centre for the Unknown
March 10

Participants: Catarina Ramos, Rui Costa (all CNP)

Café de Ciência - Mexer no Cérebro: Ciência, Ética e Sociedade

Library of the Portuguese Parliament
March 12

Participants: Pedro Ferreira, Catarina Ramos, Rui Costa (all CNP) and José Rocha, Beatriz Pamplona and Bruna Fernandes (all from Sciencecalifragilistic - 1st edition)

TEDx COLÉGIO VALSASSINA
April 30

Talk: *"O cérebro no séc. XXI: A era de brain enhancement?"*
Participant: Pedro Ferreira

NEUROCONVERSAS - NÚCLEO DE BIOLOGIA MOLECULAR E CELULAR
Faculdade de Ciências e Tecnologia,
Universidade Nova de Lisboa
November 12

Talk: *"Da ciência à sua comunicação"*
Round table: "Vem pôr os neurónios à conversa"
Participant: Catarina Ramos

SCIENCE & TECHNOLOGY WEEK
Centro Ciência Viva de Sintra
November 26

Questions & Answer Session with High school students about careers in science
Participants: Pedro Ferreira and Niccoló Bonacchi

PSEUDOSCIENCE ALERT!
November 29
Open Letter and Science Café with Neuroscientists

Participants: Gil Costa, Ana Nunes, Thiago Gouvêa, Inês Soeiro, Niccolò Bonacchi, Catarina Ramos, Susana Lima and Rui Costa

EVENTS

TO BE A HUB FOR SCIENTIFIC INTERACTION

ENGAGING OUR PEERS IN PRODUCTIVE EXCHANGE RATHER THAN COMPETITION

SEMINARS AND MEETINGS ORGANISED AT THE CCU

SCIENTIFIC MEETINGS

"One, Two, Many Brains" Workshop

18-20/09/2014

Organisers: Christian Machens, Gonzalo de Polavieja, Susana Lima (All CNP).

Administrative Coordination: Philipp Tsolakis, Catarina Ramos, Alexandra Piedade.

Workshop Summary:

What can two or many brains do that one cannot?
In this meeting, we joined researchers that study the cognitive capacities of single brains with those that study social interactions. By contrasting research on single brains with that on two or many interacting brains, the meeting highlight cognitive capabilities that emerge through social interactions.
A second and related aim of the meeting was to ask which brain mechanisms underlie social interactions and how this knowledge can be used to better understand key ingredients of social and collective behaviour.
The meeting provided a multidisciplinary and multispecies approach in a relaxed setting to allow for rich discussions and fresh ways to look at these questions.

List of speakers:

WOLFRAM SCHULTZ (University of Cambridge)
Neuronal signals for reward, risk and economic decisions

JORGE PACHECO (ATP-Group, CMAF & CBMA, Instituto para a Investigação Interdisciplinar)
Self-organization of many brains

RUI COSTA (Champalimaud Neuroscience Programme)
Generating and shaping novel action repertoires

TIAGO MAIA (Columbia University)
Simple neurocomputational mechanisms in the explanation of complex psychiatric disorders

RUI OLIVEIRA (Instituto Gulbenkian de Ciência)
Neurogenomics of social behaviour and cognition in (zebra)fish

TALI KIMCHI (Weizmann Institute of Science)
Studying the neural mechanism of social behaviour in ecologically-relevant systems

ZACHARY MAINEN (Champalimaud Neuroscience Programme)
Decision confidence

MARTA MOITA (Champalimaud Neuroscience Programme)
Regulation of defense behaviours by the social environment

BAHADOR BAHRAMI (UCL Institute of Cognitive Neuroscience)
Social influence via Confidence Sharing

ADAM KAMPFF (Champalimaud Neuroscience Programme)
Playing with Cortex: Investigations of neural representation in unpredictable environments

HIROYUKI NAKAHARA (Riken Brain Science Institute)
Primitives for neural computations underlying social decision-making

JENS KRAUSE (Leibniz-Institute of Freshwater Ecology and Inland Fisheries)
Collective Behaviour and Collective Intelligence

GONZALO DE POLAVIEJA
(Champalimaud Neuroscience Programme)
Collective decisions and how to improve wisdom of the crowds

CHRISTINE CALDWELL (University of Stirling, UK)
Experimental studies of cumulative culture in humans

MEHDI MOUSSAID (Max Plank Institute of Neurobiology)
Dynamical features of escape panics in virtual environments

BENEDETTO DE MARTINO (University of Cambridge)
Knowing what you want: confidence in value-based choice

YONATAN LOEWENSTEIN (The Hebrew University)
Synaptic volatility and the remapping of electrical activity in the córtex

ANDREW KING (Swansea University)
Social and diverse brains: the role of social complexity and individuality in collective behaviour

ETHAN BROMBERG-MARTIN (Columbia University)
Neural circuits for information seeking

MATTHEW RUSHWORTH (University of Oxford)
Brain areas for social cognition in macaques

MICHAEL PLATT (Duke University)
The Biology of Complex Social Behaviour in Primates

NIGEL FRANKS (University of Bristol)
Ants in Action: the Benefits of Many Brains

GUL DOLEN (Johns Hopkins University)
Social Reward: Basic mechanisms and Autism pathogenesis

STEVEN KUSHNER (University Medical CentreRotterdam)
The establishment and maintenance of social hierarchies in mice

GEORGE CHRISTOPOULOS (Decision and Organizational Neuroscience Lab)
Employing Hyper-Eye-Tracking to analyse decision making in competitive and cooperative environments

ONE TWO MANY BRAINS

4th Congress of Tuberous sclerosis

23/11/2014

Organisers: The Association for Tuberous Sclerosis in Portugal, Inbal Israely (CNP)
Administrative Coordination: TS Association in Portugal, Liad Hollender

Summary:
The goal of this meeting was to provide education about Tuberous Sclerosis within Portugal to families with affected members, physicians, and scientists. The meeting brought together experts from the US and within Portugal, in order to provide state of the art information about the disorder and its treatment, as well as on-site patient consultations.

Nobel Laureates Colloquium

02/05/2014

Organisers: Inbal Israely, Embassy of Israel, Portuguese Young Chemists Association
Administrative Coordination: Liad Hollender, Shira Lottem

Summary:
On May 2, 2014, three Nobel Laureates spoke at the Champalimaud Centre for the Unknown Auditorium. The first speaker, Ada Yonath, winner of the Nobel Prize in Chemistry in 2009, spoke about the journey that led her to the discovery of the structure of the Ribosome. Aaron Ciechanover, winner of the Nobel Prize in Chemistry in 2004, described how his focus on an overlooked process, protein degradation, led him to the discovery of Ubiquitin.

The final speaker, Susumu Tonegawa, winner of the Nobel Prize in Physiology or Medicine in 1987, presented some of the current work done in his laboratory, where the physiological basis of the formation of true and false memories is investigated.

Susumu Tonegawa speaks at the Nobel Laureates Colloquium

CNP Colloquia 2013

January 14, 2014

XIAO-JING WANG: *From cognitive-type local circuits to large-scale brain modeling.*

Affiliation: Computational Laboratory of cortical dynamics, The Centre for Neural Science, New York University, USA.

January 23, 2014

SHIH-CHIEH LIN: *Decision Making, Event-Related Potential and Non-Cholinergic Basal Forebrain Neurons.*

Affiliation: Laboratory of Behavioural Neuroscience, Neural Circuits and Cognition Unit National Institute on Aging, NIH, USA.

January 30, 2014

LARS CHITTKA: *Are bigger brains better?*

Affiliation: Bee Sensory and Behaviour Ecology Lab, Psychology Division, School of Biological and Chemical Sciences, Queen Mary University of London, UK.

February 06, 2014

KENJI DOYA: *Reinforcement Learning in Robots and the Brain.*

Affiliation: Okinawa Institute of Science and Technology Graduate University, Japan.

February 13, 2014

GREGORY JEFFERIS: *Sex Circuits and Brain Maps*

Affiliation: Medical Research Council, Laboratory of Molecular Biology, UK.

February 20, 2014

WILLIAM BIALEK: *More than the sum of their parts: Collective behaviour in flocks of birds and networks of neurons*

Affiliation: Joseph Henry Laboratories of Physics, Lewis-Sigler Institute for Integrative Genomics, and Department of Molecular Biology, Princeton University, Princeton, USA

March 13, 2014

KARL FRISTON: *Free energy and active inference*

Affiliation: Wellcome Trust Centre for Neuroimaging at University College London, UK

March 20, 2014

MATTHEW WILSON: *Sequential event memory formation and reactivation in the hippocampus and beyond.*

Affiliation: Department of Brain and Cognitive Sciences, MIT, USA

March 27, 2014

SARAH WOOLLEY: *Perception and generation of variability in a songbird communication signal*

Affiliation: Department of Biology, McGill University, Canada

April 10, 2014

DAEYEOL LEE: *Cortical substrates of strategic decision making*

Affiliation: Laboratory of Cognition and Decision Making, Department of Neurobiology, Yale University School of Medicine, USA.

April 24, 2014

NICKY CLAYTON & CLIVE WILKINS : *Imagination: The Door To Identity*

Affiliation: Nicky Clayton – Department of Psychology, Cambridge University, UK. Clive Wilkins – fine art painter, UK

May 8, 2014
SIDARTA RIBEIRO: *Memory, Sleep and Dreams*
Affiliation: Brain Institute, Federal University of Rio Grande do Norte, Natal, Brazil.

May 22, 2014
VENKI MURTHY: *Algorithms and neural circuits in odour-guided behaviours in mice*
Affiliation: Department of Molecular and Cellular Biology, Harvard University, USA

May 29, 2014
KRISTIN SCOTT: *Taste recognition in Drosophila*
Affiliation: Division of Molecular and Cell Biology, Helen Wills Neuroscience Institute, UC Berkeley, USA.

July 02, 2014
TETSURO MATSUZAWA: *Origins of human mind: Evolution of the brain and social behaviour in chimpanzees.*
Affiliation: Primate Research Institute, Kyoto and President of the Primatological Society of Japan, Japan.

September 04, 2014
JOHN KRAKAUER: *The motor learning problem.*
Affiliation: Centrefor the Study of Motor Learning and Brain Repair, Johns Hopkins University School of Medicine, USA.

September 17, 2014
WOLFRAM SCHULTZ: *Neuronal reward signals.*
Affiliation: Department of Physiology, Development & Neuroscience, University of Cambridge, UK.

September 23, 2014
DMITRY RINBERG: *Odour coding: temporal dissection of olfactory processing*
Affiliation: Department of Neuroscience & Physiology,NYU Neuroscience Institute, New York University, USA.

September 25, 2014
ALCINO SILVA: *Molecular, cellular and systems mechanisms of memory*
Afilliation: Integrative Centre for Learning and Memory, Department of Neurobiology, Department of Psychology, Department of Psychiatry, Integrative Centrefor Learning and Memory, Semel Institute, Brain Research Institute, University of California, USA.

October 06, 2014
DAVID LINDEN: *Long-distance regeneration of serotonin axons in the adult brain*
Affiliation: The Solomon H. Snyder Department of Neuroscience, Johns Hopkins University, School of Medicine,USA.

October 16, 2014
MARK SCHNITZER: *Reading the neural code in behaving animals, ~1000 neurons at a time*
Affiliation: Stanford University,USA.

October 23, 2014
MICHAEL MAUK: *The enemy of my enemy: Inhibition of inhibition in cerebellar learning and timing*
Affiliation: Centre for Learning and Memory, the University of Texas at Austin, USA.

October 30, 2014
WINFRIED DENK: *Connections, connections, where is the thought?*
Affiliation: Department of Biomedical Optics, Max-Planck Institute for Medical Research, Heidelberg, Germany.

November 06, 2014
MICHAEL NITABACH: *Centrifugal control of multisensory decision making in C. elegans*
Affiliation: Yale School of Medicine, USA.

November 27, 2014
MATTHEW RUSHWORTH
Affiliation: Action and Decision Laboratory, Department of Experimental Psychology, University of Oxford, UK.

December 04, 2014
JONATHAN FRITZ: *The transformation from sound to meaning - insights from the auditory cortex of the ferret.*
Affiliation: Neural Systems Laboratory, Institute for System Research, University of Maryland, USA.

December 11, 2014
MIGUEL REMONDES: *Brain maps for choice behaviour*
Affiliation: Instituto de Medicina Molecular, Portugal.

PRESENTATIONS AND MEETING ORGANISED AT INTERNATIONAL INSTITUTIONS

PRESENTATIONS

Megan Carey

- ORAL PRESENTATIONS -

MEGAN CAREY
12/09/2014
Cerebellar contributions to coordinated locomotion in mice.
Keynote lecture, Graduate Student Symposium, Janelia Farm Research Campus, Howard Hughes Medical Institute, Ashburn, VA, USA.

- POSTER PRESENTATIONS -

Machado AS, Fayad J, Darmohray D, Carey MR. *LocoMouse: a 3D markerless tracking and analysis system for freely walking mice*. FENS-2842, FENS Forum, Milan, Italy, July 2014.

Darmohray D, Carey MR. *Mouse locomotor adaptation on a split-belt treadmill*. FENS-2544, FENS Forum, Milan, Italy, July 2014.

Albergaria C, Silva NT, Carey MR. *The role of endocannabinoid signaling in delay eyelid conditioning*. FENS-2882, FENS Forum, Milan, Italy, July 2014.

Eugenia Chiappe

- ORAL PRESENTATIONS -

EUGENIA CHIAPPE
18/08/2014
Linking locomotion to motion.
Colloquium. VIB, Leuven, Belgium.

EUGENIA CHIAPPE
08/09/2014
Linking motion vision to walking.
Keynote Speaker, IMPRS/MDC Neuroscience PhD retreat, Berlin, Germany

EUGENIA CHIAPPE
24/11/2014
Linking locomotion to visual motion during walking.
Colloquium. Physics Department, Instituto Superior Técnico, Lisboa, Portugal

TOMÁS CRUZ
29/08/2014
Locomotion in tethered Drosophila melanogaster through virtual worlds
Dynamical representations of animal behaviour – why and how?
Symposium in 9th Conference of Methods and Techniques in Behavioural Research. Wagenigen, The Netherlands.

Rui Costa

– ORAL PRESENTATIONS -

RUI COSTA
02/2014
Generating and shaping novel action repertoires
Basal Ganglia Gordon Research Conference, CA, USA.

RUI COSTA
02/2014
Generating and shaping novel action repertoires
Keynote, COSYNE 2014, UT, USA.

RUI COSTA
03/2014
Generating and shaping novel action repertoires
EMBL/La Sapienza invited lecture, Rome, Italy.

RUI COSTA
04/2014
Generating and shaping novel action repertoires
Duke University, NC, USA.

RUI COSTA
04/2014
Generating and shaping novel action repertoires
Princeton University, NJ, USA.

RUI COSTA
05/2014
Generating and shaping novel action repertoires
University of Zurich, Zurich, Switzerland.

RUI COSTA
06/2014
Generating and shaping novel action repertoires
Instituto de Neurociencias de Alicante, Spain.

RUI COSTA
07/2014
Generating and shaping novel action repertoires
Roche, Basel, Switzerland.

RUI COSTA
09/2014
Generating and shaping novel action repertoires
FMI, Basel, Switzerland.

RUI COSTA
10/2014
Generating and shaping novel action repertoires
University of Geneve, Switzerland.

RUI COSTA
10/2014
Generating and shaping novel action repertoires
Institut du Fer a Moulin, Paris, France.

RUI COSTA
10/2014
Generating and shaping novel action repertoires
EMBO Members Meeting, Heidelberg, Germany.

RUI COSTA
10/2014
Learning New actions and Shifting to Automatic
Molecular and Cellular Cognition Society, Washington DC, USA

RUI COSTA
11/2014
The Acting Brain
Meet the Expert, Society for Neuroscience Meeting, DC, USA

RUI COSTA
11/2014
Generating and shaping novel action repertoires
Keynote, Society for Neuroscience Meeting, Washington DC, USA

RUI COSTA
12/2014
Shifting between Basal Ganglia Circuits for Different Action Strategies
Simmons Foundation, NY, USA.

RUI COSTA
12/2014
Generating and shaping novel action repertoires
University of Oxford, Oxford, UK.

RUI COSTA
12/2014
Generating and shaping novel action repertoires
FIL, UCL, London, UK.

– POSTER PRESENTATIONS –

Martins GJ, Prado MAM, Costa RM. *Learning and Memory: Skill-Learning.* Annual meeting of the Society for Neuroscience 2014, Washington DC, USA.

Clancy K, Koralek A, Costa RM, Feldman D, Carmena J. *Neuroprosthetics.* Annual meeting of the Society for Neuroscience 2014, Washington DC, USA.

Castro AC, Silva J, Oliveira-Maia A, Costa RM. *Motivation and Reward.* Annual meeting of the Society for Neuroscience 2014, Washington DC, USA.

McElvain LE, Costa EM. *Basal Ganglia: Cellular Physiology.* Annual meeting of the Society for Neuroscience 2014, Washington DC, USA.

French CA, Gomez-Marin A, Correia M, Feliciano C, Paixão VB, Jin X, Fisher SE, Costa RM. *Developmental disorders: Animal Models II.* Annual meeting of the Society for Neuroscience 2014, Washington DC, USA.

Alves Da Silva J, Tecuapetla F, Paixão VB, Costa RM. *Systmes physiology and Behaviour.* Annual meeting of the Society for Neuroscience 2014, Washington DC, USA.

Fernandes AB, Costa RM, Oliveira-Maia AJ. *Integration of Peripheral Signals: Systems.* Annual meeting of the Society for Neuroscience 2014, Washington DC, USA.

Gonzalo de Polavieja

– ORAL PRESENTATIONS -

GONZALO DE POLAVIEJA
03-06/09/2014
Collective decisions
XV Congreso Nacional y XII Iberoamericano de la Sociedad Española de Etología
Barcelona, Spain

GONZALO DE POLAVIEJA
18-20/09/2014
Decision-making in collectives and how to improve wisdom of the crowds
Workshop 'one, two & many brains'.
Champalimaud Foundation, Lisbon, Portugal.

GONZALO DE POLAVIEJA
14/10/2014
Decision-making in animal groups. 'Life in the aggregate'
Janelia Farm, USA

Inbal Israely

– ORAL PRESENTATIONS -

INBAL ISRAELY
25/03/2014
Long term depression mediated restructuring of synaptic inputs.
Institute of Pharmacology and Toxicology, University of Zurich, Switzerland.

– POSTER PRESENTATIONS -

Ramiro-Cortés Y, Israely I. *Bidirectional structural changes driven by protein synthesis-dependent activity at individual spines.* Annual meeting of the Society for Neuroscience 2014, Washington DC, USA.

Ramiro-Cortés Y, Israely I. *Structural plasticity at single spines via mGluRs: implications for neuronal connectivity and function.* Gordon Research Conference on Fragile X and Autism-Related Disorders, 2014, West Dover, VT, USA.

Adam Kampff

– ORAL PRESENTATIONS -

ADAM KAMPFF
11/04/ 2014
Moving with cortex: New techniques for studying behaviours that require motor cortex
Winter Neuroscience Conference, Sölden, Austria

ADAM KAMPFF
18/09/2014
Playing with cortex: Investigations of neural representation in unpredictable environments.
"One, Two, Many Brains" Workshop, Estoril, Portugal

ADAM KAMPFF
25/09/2014
Moving with cortex: New techniques for studying behaviours that require motor cortex.
Basel Seminars in Neuroscience, FMI, Basel, Switzerland

ADAM KAMPFF
07/11/2014:
Playing with cortex: New techniques for studying behaviours that require motor cortex.
ETH, Zurich, Switzerland

Susana Lima

– ORAL PRESENTATIONS -

SUSANA LIMA
29/01/2014
On the hypothalamus and other things
University Coimbra, Neurasmus Master Program, Portugal

Christian Machens

– ORAL PRESENTATIONS -

CHRISTIAN MACHENS
04/2014
Optimal Compensation for Neuron Death
Gatsby Computational Neuroscience Unit, University College London, UK

CHRISTIAN MACHENS
06/2014
Optimal Compensation for Neuron Death
Janelia Farm Campus, HHMI, Washington DC, USA

CHRISTIAN MACHENS
06/2014
Optimal Compensation for Neuron Death
Swartz Meeting, Seattle, USA

ASMA MOTIWALA
08/2014
Quantifying continuous behaviour to account for neural variability
Conference on Measuring Behaviour, Wageningen, Netherlands

CHRISTIAN MACHENS
09/2014
Optimal Compensation for Neuron Death
Bernstein Conference, Goettingen, Germany

– POSTER PRESENTATIONS -

Brendel W*, Kobak D*, Romo R, Feierstein C, Mainen Z, Machens C, *Orthogonal representation of task parameters in higher cortical areas*, Cosyne, Feb 2014, Salt Lake City, USA.

Barrett D, Deneve S, Machens CK, *Optimal Compensation for Neuron Death*, Cosyne , Feb 2014, Salt Lake City, USA.

Kobak D*, Brendel W*, Constantinidis C, Feierstein C, Kepecs A, Mainen Z, Romo R, Qi X-L, Uchida N, Machens C, *Independent representation of task parameters in higher cortical areas,* AREADNE, Jun 2014, Santorini, Greece.

Semedo J, Zandvakili A, Kohn A, Machens CK*, Yu B*, *Extracting Latent Structure From Multiple Interacting Neural Populations,* NIPS, Dec 2014, Montreal, Canada.

Vertechi P*, Brendel W*, Machens CK, *Unsupervised learning of an efficient short-term memory network,* NIPS, Dec 2014, Montreal, Canada.

Zachary Mainen

– ORAL PRESENTATIONS-

ZACHARY MAINEN
04/03/2014
Neural mechanisms for action timing in the rat frontal cortex
CoSyNe workshops, Snowbird, USA

ZACHARY MAINEN
10/04/2014
Neural circuits for spontaneous action timing in the frontal cortex
16th International Neuroscience Winter Conference, Sölden, Austria

ZACHARY MAINEN
21/04/2014
Neural mechanisms controlling self-initiated action
"Controlling Neurons, Circuits, Behaviour", FENS Spring Brain Conference, Rungstedgaard, Copenhagen, Denmark

ZACHARY MAINEN
02/06/2014
Neural circuits for spontaneous action timing in the frontal cortex
79th Cold Spring Harbor Symposium on Quantitative Biology "Cognition", Cold Spring Harbor, New York, USA

ZACHARY MAINEN
08/08/2014
Neuroscience and the Limits of Consciousness
Boom Festival, Idanha-a-Nova, Portugal

ZACHARY MAINEN
19/09/2014
Decision confidence.
Workshop "One, two, many brains", Estoril, Portugal

RITA VENTURINI
25/10/2014
Habits and Improvisation
Science and Non Duality Annual Conference, San Jose', California, USA

ZACHARY MAINEN
30/10/2014
Round table: Setting up a successful scientific career in Portugal
1st joint Postdoc meeting IMM, IGC, CEDOC, Sintra, Portugal

RITA VENTURINI
08/11/2014
Reinventing the Predictable: From Habit to Improvisation
Applied Improvisation Network World Conference, Austin, Texas, USA

ZACHARY MAINEN
02/12/2014
On neuronal 'noise' and its implications for our understanding of the brain
"The aims of brain research: scientific and philosophical perspective", The 28th Annual International Workshop on the History and Philosophy of Science, Van Leer Jerusalem Institute, Israel

– POSTER PRESENTATIONS -

Fonseca MS, Murakami M, Mainen ZF. *Optical activation of dorsal raphe serotonin neurons is sufficient to facilitate waiting for delayed rewards.* Society for Neuroscience Meeting 2014, Washington, D. C., USA.

Correia PA, Valente SS, Lima SQ and Mainen ZF (2014) *Neuromodulation of sexual behaviour: a role for serotonin? Controlling Neurons, Circuits and Behaviour,* Federation of European Neurosciences Societies, Copenhagen, Denmark.

Correia PA, Valente SS, Lima SQ and Mainen ZF (2014) *Neuromodulation of sexual behaviour: a role for serotonin?* 9th Federation of European Neuroscience Societies Forum, Milan, Italy.

Venturini R, Johnson H, de Witt E and Mainen Z (2014) *Confidence, Waiting Time and Feedback* Cold Spring Harbor Laboratories, Cognition Symposium, 2014, Cold Spring Harbor, NY, USA.

Marta Moita

– ORAL PRESENTATIONS -

MARTA MOITA
10/02/2014
You are not alone: Fear in the context of social interactions
JORTEC de Química, Bioquímica e Biotecnologia
Coimbra, Portugal

MARTA MOITA
26/05/2014
You are not alone: Fear in the context of social interactions
Faculty of Biological Sciences, University of Valencia, Spain

MARTA MOITA
27/05/2014
You are not alone: Fear in the context of social interactions
Institute de Neurociencias de Alicante, Spain

MARTA MOITA
09-12/09/2014
Defence behaviours in fruit flies.
Junior European *Drosophila* Investigator Meeting
Marseille, France

MARTA MOITA
19/09/2014
Regulation of defense behaviours by the social environment.
Workshop "One, two, many brains", Estoril, Portugal

MARTA MOITA
09/10/2014
You are not alone: Fear in the context of social interactions
XI Congresso da Sociedade Portuguesade Etologia
CIBIO, Portugal

MARTA MOITA
24/10/2014
Regulation of defense behaviours by the social environment.
XVIII Curso da Sociedade Portuguesa de Neurocirurgia
Monte Real, Portugal

CRISTINA MARQUEZ
22/12/2014
Prosocial choice in rats depends on food-seeking behaviour displayed by recipients
Institute de Neurociencias de Alicante, Spain
Best talk award

– POSTER PRESENTATIONS-

Rickenbacher E, Perry R, Szyba K, Al Ain S, Sullivan R, Moita M. *Oxytocin in the central nucleus of the amygdala gates freezing allowing for maternal defense responses and transmission of fear to offspring.* Society for Neuroscience Meeting, 2014, Washington DC, USA.

Cruz A, Moita MA. Been there, done that: *Experiencing freezing is required for observational fear in the context of social interactions.* Society for Neuroscience Meeting, 2014, Washington DC, USA.

Pereira A, Lima SQ, Moita MA. Fearful silence: *The role of lateral amygdala and its auditory inputs in social transmission of fear.* Society for Neuroscience Meeting, 2014, Washington DC, USA.

Marquez C, Rennie S, Costa D, Moita M. P*rosocial behaviour in rats depends on the delivery of food to another rat displaying food seeking behaviour.* Society for Neuroscience Meeting, 2014, Washington DC, USA.

Marquez C, Rennie S, Costa D, Moita M. *Rats cooperate in the absence of direct benefit: Developement of a new behavioural task.* The Brain Conferences: Controlling neurons, circuits and behaviour. April 2014 Rungstedgaard, Copenhagen, Denmark. **Best poster award.**

Michael Orger

– ORAL PRESENTATIONS -

MICHAEL ORGER
05/2014
Cold Spring Harbor Asia Conference: The Neural Circuit Basis of Behaviour and its Disorders.
Suzhou, China

MICHAEL ORGER
07/2014
Symposium: Linking neural circuits to behaviour in zebrafish.
FENS Forum, Milan, Italy.

MICHAEL ORGER
09/2014
Signal Transforms in the Early Visual System.
HHMI Janelia Farm, USA.

MICHAEL ORGER
10/2014
The Physical Basis of Biological Systems.
Munich, Germany.

MICHAEL ORGER
12/2014
3rd European Symposium on Imaging Structure and Function in Zebrafish Brain.
Paris, France.

Joe Paton

– ORAL PRESENTATIONS -

JOE PATON
09/06/2014
A neural population code for time in the striatum
Oxford University, Oxford, U.K.

JOE PATON
02/09/2014
Population coding of time in the rodent striatum
Bernstein Conference, Satellite workshop: Neural representations of time, experiments models, theory. Göttingen, Germany

JOE PATON
14/11/2014
Time encoding in the rodent basal ganglia
SFN pre-meeting, Birdsong: Rhythm and clues from neurons to behaviour.
Georgetown University, Washington D.C., USA

– POSTER PRESENTATIONS -

Gouvea TS, Monteiro T, Motiwala A, Paton J. *Continuous psychometric-neurometric comparison in a perceptual decision making task*. CoSyNe meeting 2014. Salt Lake City, UT. USA.

Leopoldo Petreanu

– ORAL PRESENTATIONS -

LEOPOLDO PETREANU
12/05/2014
The structure and function of cortico-cortical connections
Universite Paris Descartes, France

LEOPOLDO PETREANU
23/10/2014
The structure and function of long-range cortical circuits
Biozentrum, University of Basel, Switzerland.

LEOPOLDO PETREANU
08/12/2014
The structure and function of long-range cortical connections
Brain Research Institute, University of Zurich, Switzerland.

LEOPOLDO PETREANU
13/12/2014
The structure and function of cortico-cortical connections
Instituto de Telecomunicações, Instituto Superior Técnico, Portugal

– POSTER PRESENTATIONS -

Morgenstern N, Petreanu L. *Interconnected layer 4 neurons in the mouse visual cortex receive common inputs from the lateral geniculate nucleus.* Society for Neuroscience 2014, Washington, USA.

Marques T, Dias R, Petreanu L. *A cortex-dependent motion discrimination task in head-fixed mice.* Society for Neuroscience 2014, Washington, USA.

Alfonso Renart

– ORAL PRESENTATIONS -

ALFONSO RENART
10/02/2014
Studying the dynamics of cortical circuits.
JORTEC 2014. Lisbon, Portugal

ALFONSO RENART
03/03/2014
Excitatory-Inhibitory coupling in recurrent neural circuits.
Cosyne 2014 Workshop Excitatory and Inhibitory Synaptic Conductances: Functional Roles and Inference Methods. Salt Lake City, Utah.

ALFONSO RENART
19/03/2014
Dynamics of cortical neuronal populations.
Instituto Superior Técnico, Lisbon, Portugal.

ALFONSO RENART
2/04/2014
Transient competitive amplification in cortical circuits.
Gatsby Computational Neuroscience Unit, University College, London, UK.

ALFONSO RENART
4/04/2014
Transient competitive amplification in cortical circuits.
Institute for NeuroInformatics, Zurich, Switzerland.

ALFONSO RENART
11/09/2014
Excitatory-Inhibitory coupling in recurrent neural circuits.
Summer Course on Computational Neuroscience, Gottingen, Germany.

ALFONSO RENART
25/12/2014
Transient competitive amplification in cortical circuits.
Technion, Haifa, Israel.

– POSTER PRESENTATIONS -

Vaconcelos NA, Bourg J, Wimmer K, Compte A, de la Rocha J, Renart A. *Transient competitive amplification in cortical circuits.* 44th annual meeting of the SfN. Washington DC. November 15, 2014.

Medina R, Pardo-Vazquez JL, Renart A. Online behavioural readouts in an auditory perceptual decision making task. 44th annual meeting of the SfN. Washington DC. November 15, 2014.

Pardo-Vazquez JL, Renart A. *Level invariant inter-aural level difference discrimination in rats.* 44th annual meeting of the SfN. Washington DC. November 19, 2014.

Carlos Ribeiro

– ORAL PRESENTATIONS -

CARLOS RIBEIRO
18/02/014
The gourmet fly – using iPads to study essential and non-essential decisions in Drosophila
EPFL, Lausanne, Switzerland

CARLOS RIBEIRO
09/07/2014
flyPAD: a high throughput and temporal resolution feeding sensor for flies
14th Human Frontiers Science Program (HFSP) Awardees Meeting, Lugano, Switzerland

CARLOS RIBEIRO
11/09/2014
Using iPad technology to study nutrient homeostasis
4th Junior European *Drosophila* Investigator meeting, Carry-le-Rouet, France

CARLOS RIBEIRO
12/11/2014
The gourmet fly - the behavioural, nutritional, and neuronal basis of nutrient homeostasis
ESF-EMBO minibrains symposium: "Flies, worms and robots: combining perspectives on minibrains and behaviour", Sant Feliu de Guixols, Spain

VERONICA CORRALES:
19/07/2014
Elucidating the effect of internal state on Drosophila feeding decisions
VII European Conference on Behavioural Biology. Prague, Czech Republic.

VERONICA CORRALES
29/08/2014
Deconstructing the value-based serial decision making process in Drosophila foraging.
Measuring Behaviour 2014. 9th International Conference on Methods and Techniques in Behavioural Research. Wageningen, The Netherlands.

ITSKOV PM, Moreira J-M, Vinnik E, Lopes G, Safarik S, Dickinson MH, Ribeiro C::
27-29/08/2014
Automatic high throughput measurement of feeding behaviour in Drosophila.
Measuring Behaviour 2014, Waageningen, The Netherlands

KATHRIN STECK, Célia Baltazar, Ana Paula Elias, Carolina Doran, Carlos Ribeiro:
07/08/2014
Making sense of yeast sensing
Xth European Congress of Entomology. University of York, UK.

SAMUEL WALKER
03/11/2014
FLiACT Annual Meeting
Leuven, Belgium

– POSTER PRESENTATIONS -

Itskov PM, Moreira J-M, Vinnik E, Lopes G, Safarik S, Dickinson MH, Ribeiro C. FlyPAD - *Automatic High Throughput Measurement of Feeding Behaviour in Drosophila.* Neurofly Meeting, Hersonissos, Grece, October 2014.

Walker S. ESF/EMBO conference *Flies, Worms & Robots: combining perspectives on minibrains & behaviour.* San Feliu de Guixols, Spain, November, 2014.

Noam Shemesh

– ORAL PRESENTATIONS -

Alvarez GA, SHEMESH N, Frydman L
09-13/02/2014
Coherent dynamical recoupling of diffusion-driven decoherence in magnetic resonance.
The 12th International Bologna conference on Magnetic Resonance in Porous Media (MRPM), Wellington, New Zealand.

SHEMESH N, Rosenberg JT, Grant SC, Frydman L.
23-28/03/2014
In-vivo Longitudinal Relaxation Enhancement (LRE) of brain metabolites: Superior 1H MRS and novel biomarkers
The 55th Experimental NMR Conference, Boston, MA, USA.

NOAM SHEMESH
05/2014
Higher order diffusion models and methods: going beyond the diffusion tensor.
Educational Sessions, International Society of Magnetic Resonance in Medicine (ISMRM) Scientific Meeting, Milan, Italy.

SHEMESH N, Rosenberg JT, Grant SC, Frydman L.
10-16/05/2014
Metabolic confinements in normal and stroked CNS in-vivo revealed by localized double-Pulsed-Field-Gradient MRS at 21.1
The 22nd Scientific Meeting of the International Society for Magnetic Resonance in Medicine, Milan, Italy.

SHEMESH N, Alvarez GA, Frydman L
10-16/05/2014
Cellular size distributions revealed by Non-uniform Oscillating-Gradient Spin-Echo (NOGSE)-MRI.
The 22nd Scientific Meeting of the International Society for Magnetic Resonance in Medicine, Milan, Italy.

SHEMESH N, Alvarez GA, Frydman L.
10-16/05/2014
The internal gradient distribution tensor as a new source for orientation contrast in the CNS.
The 22nd Scientific Meeting of the International Society for Magnetic Resonance in Medicine, Milan, Italy.

– POSTER PRESENTATIONS -

Shemesh N, Alvarez GA, Frydman L. *Non-uniform Oscillating-Gradient Spin-Echo MRI: A novel ultrasensitive micro-architectural probe.* The 55th Experimental NMR Conference, Boston, MA, USA, March 23rd-28th 2014.

Shemesh N, Rosenberg JT, Grant SC, Frydman L. *In-vivo Longitudinal Relaxation Enhancement (LRE) of brain metabolites at 21.1T* The 22nd Scientific Meeting of the International Society for Magnetic Resonance in Medicine, Milan, Italy, May 10th-16th 2014.

Maria Luísa Vasconcelos

– ORAL PRESENTATIONS -

MARIA LUISA VASCONCELOS
06/09/2014
An inhibitory behavioural screen identifies neurons involved in female receptivity behaviour
Portuguese fly meeting, Tomar, Portugal

MARIA LUISA VASCONCELOS
13/09/2014
An inhibitory behavioural screen identifies neurons involved in female receptivity behaviour
Junior European *Drosophila* Investigators, Marseille, France

MARIA LUISA VASCONCELOS
19/09/2014
Unraveling the circuit of CO2 response at the lateral horn
Brains and Roses meeting, College de France, Paris, France

MARIA LUISA VASCONCELOS
29/09/2014
Circuits of innate behaviour
CNBC, Oxford University, UK

– POSTER PRESENTATIONS -

Márcia M. Aranha, Sophie Dias, Anita Sousa, Maria Luisa Vasconcelos. *A GAL4 screen identifies neurons involved in female receptivity behaviour.* 9th FENS Forum of Neuroscience, 2014, Milan, Italy.

Márcia M. Aranha, Hugo Cachitas, Sophie Dias, Anita Sousa, Maria Luisa Vasconcelos. *Unraveling new neural substrates for Drosophila female receptivity.* Decoding neural circuit structure and function- EMBO workshop, 2014, Istanbul, Turkey.

Márcia M. Aranha, Sophie Dias, Anita Sousa, Maria Luisa Vasconcelos. *An inhibitory behavioural screen identifies neurons involved in female receptivity behaviour.* Janelia Conference - Neural circuits controlling sexual behaviours, 2014, Virginia, USA.

MEETINGS

HHMI Janelia Farm meeting on temporal dynamics in learning: networks and neural data

13-16 May 2014.
Ashburn, VA., U.S.A.
Organisers: JOE PATON, Joshua T. Dudman, Alla Karpova.

Summary:
Recent developments in multielectrode recording methods and imaging have unveiled a wealth of data about the dynamics of neural circuits during behaviour in animal model systems. In parallel, theoreticians have developed abstract network models that combine rich temporal dynamics with plastic synapses to produce powerful learning and discriminative mechanisms. This meeting aims to bring together experimentalists and theoreticians in an attempt to compare abstract circuit models to experimental evidence from neural circuits in behaving animals. The goal is for participants to bridge the gap between theory and experiment by identifying principles of neural circuit operation that may subserve and promote adaptive behaviour.

Interactivos 2014 at Medialab Prado

11-23 November, 2014.
Madrid, Spain.
Director: GONZALO DE POLAVIEJA

Summary:
This was a 2-week workshop joining people from arts, engineering and science to produce prototypes related to social behaviour.

Transylvania Experimental Neuroscience Summer School (TENSS)

June 2014.
Pike Lake, Cluj-Napoca, Romania.
Course Organizers: Raul Mureşan, ADAM KAMPFF, Florin Albeanu

Summary:
TENSS concentrates top-level international expertise to teach a dozen students techniques and concepts in experimental systems neuroscience. We focus on modern optical and electrophysiological methods to study the connectivity and function of neuronal circuits. The course is designed to be intensive and highly interactive, including both lab sessions and theoretical lectures. Coursework will take place in a land of myth and legend, beyond large forests (Transylvania), on the shores of a picturesque natural reserve called Pike Lake. Applications are welcome from interested (and interesting) graduate students and postdocs.

Advanced Course in Computational Neuroscience (Summer School)

Aug 03-30, 2014.
Frankfurt, Germany.
Organisers: Ehud Ahissar, Dieter Jaeger, Máté Lengyel, CHRISTIAN MACHENS.

Summary:
This course is for advanced graduate students and postdoctoral fellows who are interested in learning the essentials of the field of computational neuroscience. The course has two complementary parts. Mornings are devoted to lectures given by distinguished international faculty on topics across the breadth of experimental and computational neuroscience. During the rest of the day, students pursue a project of their choosing under the close supervision of expert tutors. This gives them practical training in the art and practice of neural modeling.

FENS Forum 2014

July 05-09, 2014.
Copenhagen, Denmark.
Chair of the Programme Committee of the FENS Forum: RUI COSTA. (Position throughout 2014-2016).

Summary:
The FENS Forum of Neuroscience is the largest international neuroscience meeting in Europe, involving all neuroscience societies' members of FENS, and held biannually on every even year. The FENS Forum strives to promote excellence in neuroscience research in Europe at large and to facilitate the interaction between scientists in and outside Europe. Participants in the FENS Forums are scientists at all career levels working in all areas of neuroscience research. Students and early career researchers are extensively represented as a group in the Forum.

Cold Spring Harbor Asia Conference on Neural Circuit Basis of Behaviour and its Disorders.

May 12-16, 2014,
Suzhou, China.
Organisers: RUI COSTA, Guoping Feng, Yasunori Hayashi, Minmin Luo.

Summary:
The conference included eight oral sessions and one poster session covering the latest findings across many topics in neural circuit research. Many talks were selected from the

openly submitted abstracts on the basis of scientific merit and relevance. Social events throughout the conference provided ample opportunity for informal interactions.

Computational and Systems Neuroscience - Cosyne 2014

Main meeting: February 27 - March 2, 2014, Salt Lake City, USA
Workshops: March 3 - 4, 2014, Snowbird, Utah, USA
Organizers (Executive Committee): Anne Churchland, ZACHARY MAINEN, Alexandre Pouget, Anthony Zador.

Summary:
The annual Cosyne meeting provides an inclusive forum for the exchange of experimental and theoretical/computational approaches to problems in systems neuroscience. To encourage interdisciplinary interactions, the main meeting is arranged in a single track. A set of invited talks are selected by the Executive Committee and Organizing Committee, and additional talks and posters are selected by the Program Committee, based on submitted abstracts. Cosyne topics include (but are not limited to): neural coding, natural scene statistics, dendritic computation, neural basis of persistent activity, nonlinear receptive field mapping, representations of time and sequence, reward systems, decision-making, synaptic plasticity, map formation and plasticity, population coding, attention, and computation with spiking networks. Participants include pure experimentalists, pure theorists, and everything in between.

Computational and Cognitive Neuroscience Summer School

July 05 - 23, 2014.
Cold Spring Harbor Asia, Suzhou & Beijing, China
Organizers: Xiao-Jing Wang, ZACHARY MAINEN, Si Wum Upi Bhalla.
Instructors: ERIC DEWITT.

Summary:
The 5th Computational and Cognitive Neuroscience (CCN) summer school will be held in Shanghai, China. Designed to emphasize higher cognitive functions and their underlying neural circuit mechanisms, the course aims at training talented and highly motivated students and postdoctoral fellows from Asia and other countries in the world. Applicants with quantitative (including Physics, Mathematics, Engineering and Computer Science) or experimental background are welcomed. The lectures will introduce the basic concepts and methods, as well as cutting-edge research on higher brain functions such as decision-making, attention, learning and memory. Modeling will be taught at multiple levels, ranging from single neuron computation, microcircuits and large-scale systems, to normative theoretical approach. Python and Matlab-based programming labs coordinated with the lectures will provide practical training in important computational methods.

CULTURE

TO PROMOTE COLLECTIVE ACHIEVEMENTS

BEYOND THOSE REACHABLE BY INDIVIDUAL SCIENTISTS OR LABORATORY GROUPS

As one of the means to create an environment where individual researchers, in all career stages, are familiar with each other and each other's work, several activities, both scientific and social, happen regularly at the CCU.

CHAMPALIMAUD INTERNAL SEMINARS SERIES (CISS)

Each week, two CNP researchers deliver a 25- minute presentation of their work, after which they receive feedback and questions from the CNP community. These events, in addition to creating an atmosphere that facilitates collaboration, also provide a platform for junior researchers to advance their skills in preparing and delivering oral presentations to large audiences.

In 2014, 67 CNP researchers presented at CISS.

2014 CNP ANNUAL RETREAT

A central event shared by all CNP members is the CNP annual retreat. Each June, all CNP members travel together to a remote location where they dedicate five days to getting reacquainted with each other's research and to simply having a good time together.

In 2014, the main activity at the retreat was an elaborate game targeted to explore the scientific system itself. The game, developed by a group of CNP members, was called Scientopia. The game was designed as a simplified version of the scientific world, consisting of 3 main groups – the scientists, the editors and the funders. The game engaged nearly 200 players simultaneously and led to discussions and brainstorming sessions where the strengths and weaknesses of the current scientific system were contemplated upon each day.


CHANGE
P. I. G. S.
EDITOR


Antonia
Groneberg

FRIDAY'S HAPPY HOUR

These weekly events provide an informal setting where CNP members socialise over snacks and drinks. Each week, Friday's Happy Hour is hosted by two different labs that create fun thematic events. Family members and children are also frequent visitors of Friday's Happy Hour, which is always a great way to start the weekend.

EDUCATION

TO ENCOURAGE ACTIVE PARTICIPATION

CRITICAL THINKING AND INDEPENDENCE OF THOUGHT

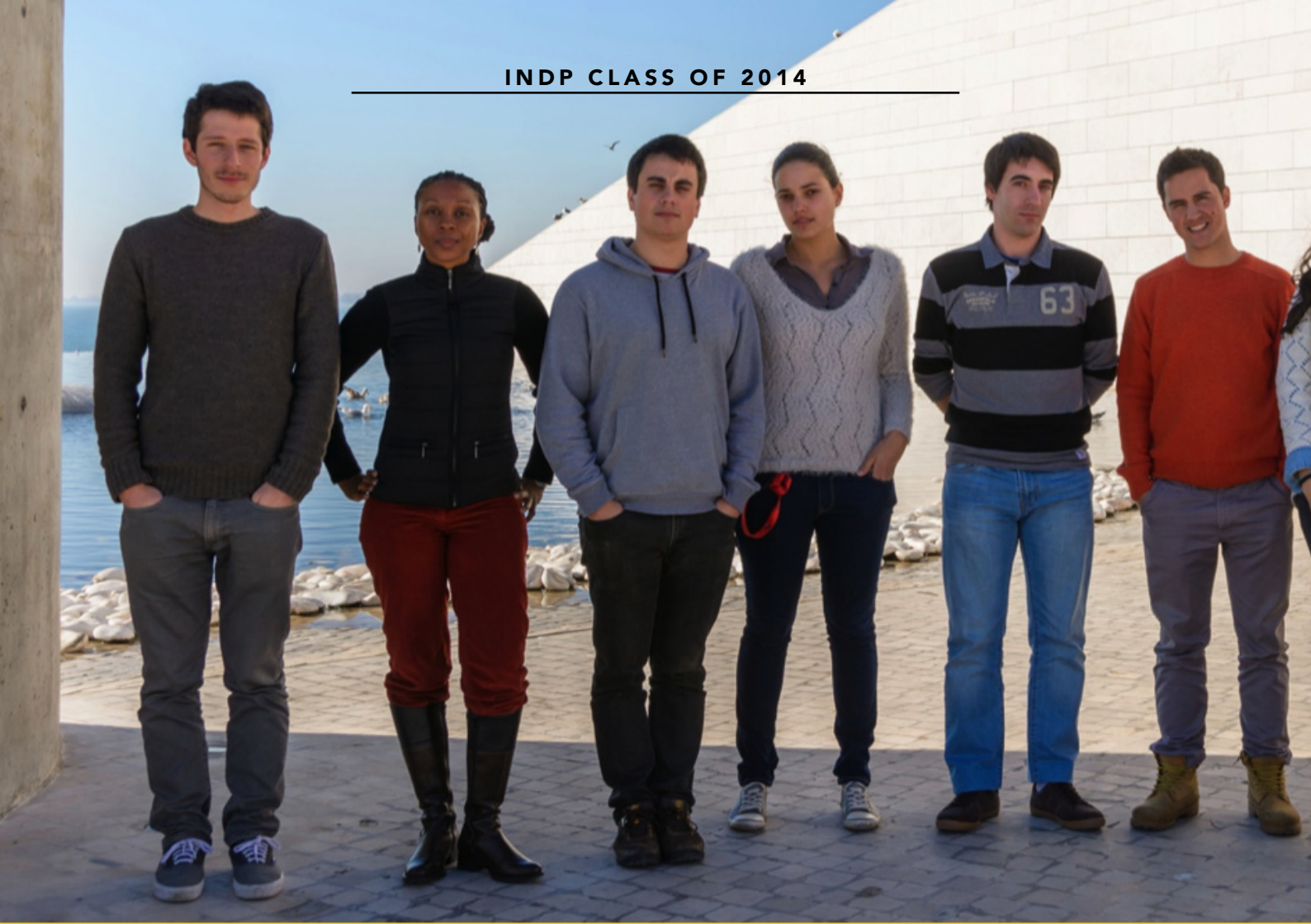
INTERNATIONAL NEUROSCIENCE DOCTORAL PROGRAMME (INDP)

The INDP aims at providing students with a broad and integrative education in neuroscience with a focus on the neuronal and circuit basis of behaviour. A main goal of the programme is to foster and encourage active participation, independence and critical thinking on the part of the students. In the first semester of the programme, students attend courses structured as modules lasting one or a few weeks which cover basic topics in contemporary neuroscience such as basic cellular and synaptic physiology, sensation and action and cognitive neuroscience. Courses have a strong practical component which includes a variety of experimental preparations developed by students in the CNP dedicated teaching lab, as well as basics in software and computer data acquisition. During the 3-4 months following the courses, students perform lab rotations, which allow them to familiarise themselves with the research done in the different labs, and which culminate with the selection of a laboratory by each student. The next three years are dedicated to research on a specific topic leading to a PhD thesis. No previous background in neuroscience is required, but candidates with a background in biology or quantitative disciplines are encouraged to apply.

ALFONSO RENART
Programme Director

ALEXANDRA PIEDADE,
TERESA CARONA
Administrative Assistants

INDP CLASS OF 2014



(from left to right)

PIETRO VERTECHI
MSc in Mathematics
Ecole Normale Supérieure de Paris

THABELO KHOBOKO
MSc in Neuroscience
University of Arizona

BRUNO CRUZ
MSc in Molecular and Cell Biology
University Coimbra

INÊS VAZ
MSc in Molecular and Cell Biology
Universidade do Minho

TOMÁS CRUZ
MSc in Physics
Instituto Superior Técnico
da Universidade Técnica de Lisboa

FRANCISCO ROMERO
MSc in Physics
Universidad Politécnica de Madrid

TATIANA SILVA
MSc in Biology
University of Coimbra

MIGUEL GASPAR
MSc in Biology
Faculdade de Ciências
da Universidade de Lisboa

2014 TEACHING MODULES

HISTORY OF BIOLOGICAL CONCEPTS

13-17 Jan
Coordinators: Élio Sucena (IGC)

INTRODUCTION TO SCIENTIFIC HARDWARE & SOFTWARE

20-24 Jan
Coordinators: Adam Kampff
Instructors: Gonçalo Lopes, Danbee Kim, Niccolò Bonachi

EXPERIMENTAL TECHNIQUES OF NEUROSCIENCE

27-31 Jan
Coordinators: Adam Kampff
Instructors: Joana Neto, João Frazão Adam Kampff

CELLULAR & SYNAPTIC PHYSIOLOGY I

3-7 Feb
Coordinators: Alfonso Renart, Joe Paton, Marta Moita and Inbal Israely
Instructors: Cindy Poo, Bassam Attalah, Thomas Akam and Lauren McElvain

CELLULAR & SYNAPTIC PHYSIOLOGY II

10-14 Feb
Coordinators: Alfonso Renart, Joe Paton, Marta Moita and Inbal Israely
Instructors: Cindy Poo, Bassam Attalah, Thomas Akam and Lauren McElvain

CELLULAR & SYNAPTIC PHYSIOLOGY III

17-21 Feb
Coordinators: Alfonso Renart, Joe Paton, Marta Moita and Inbal Israely
Instructors: Cindy Poo, Bassam Attalah, Thomas Akam and Lauren McElvain

CELLULAR & SYNAPTIC PHYSIOLOGY IV

24-28 Feb
Coordinators: Alfonso Renart, Joe Paton, Marta Moita and Inbal Israely
Instructors: Cindy Poo, Bassam Attalah, Thomas Akam and Lauren McElvain

ANATOMY & DEVELOPMENT I

3-7 Mar
Coordinators: Luísa Vasconcelos and Carlos Ribeiro
Instructors: Joshua Corbin (Children's Research Institute, USA), Isabel Campos

EVOLUTION

17-21 Mar
Coordinators: Isabel Gordo and Lounès Chikhi (IGC)

SENSATION & PERCEPTION

31 Mar – 4 Apr
Coordinators: Joe Paton and Leopoldo Petreanu
Instructors: Virginia Flanagin (Ludqig-Max Univ Muchen, Germany)

MOVEMENT & ACTION

7 Apr – 11 Apr
Coordinators: Megan Carey and Rui Costa

DRIVE

21-25 Apr
Coordinators: Carlos Ribeiro and Susana Lima
Instructors: Giorgio Gilestro (Imperial College London, UK)

ANIMAL BEHAVIOUR

28 Apr – 2 May
Coordinators: Marta Moita and Susana Lima
Instructors: Joe Paton and Gabriela Martins

NEUROETHOLOGY

5 – 9 May
Coordinators: Eugenia Chiappe & Michael Orger
Instructors: Damon Clark (Yale, USA), Matthieu Louis (CRG, Spain); Terufumi Fujiwara, Tomas Cruz, Joao Marques.

LAB

12-16 May
Coordinators: Adam Kampff

COGNITION

19-23 May
Coordinators: Zachary Mainen and Marta Moita
Instructors: Alfonso Renart (CNP - FC) & Gonzalo Polavieja (Cajal Institute); André Mendonça & Maria Vicente, José Pardo-Vazquez & Roberto Medina

COMMUNICATION

26-30 May
Coordinators: Catarina Ramos, Gil Costa and Liad Hollender
Instructors: Carlos Catalão Alves (Ciência Viva, Portugal), António Granado (Universidade Nova de Lisboa, Portugal), Eric DeWitt, Manuel Lima (Codademy, Microsoft, Nokia), Brigitta Gundersen (Nature Neuroscience, UK), Michael Orger, Joe Paton, Alex Gomez-Marin

LAB

2 – 13 Jun
Coordinators: Adam Kampff

VARIABILITY IN BIOLOGY

26 – 28/03/2014

Organisers: Alex Gomez-Marin, Alfonso Renart, Asma Motiwala, Nuno Calaim (All CNP)

Administrative Coordination: Tânia Li Chen, Alexandra Piedade

Accounting for variability in data is a common challenge in working with a wide range of real world systems. This is especially true for biological systems that are typically complex, high-dimensional, structured and poorly understood. Biologists in general and neuroscientists in particular are very familiar with generally being able to explain only a small fraction of the variability in their data. How should one confront the observed variability? Is the ubiquitous variability found in biological systems a feature necessary for producing function or an inevitable side-effect which should be suppressed?

The aim of the workshop was to create a forum for discussion about several topics related to variability in biological systems and in the brain. These issues are still open and general enough that approaches from different fields can potentially be valuable in others. Hence, a diverse set of themes and perspectives regarding the notion of variability was addressed. The workshop was conceived as an opportunity for open discussion and cross-disciplinary interactions, both, amongst the invited faculty as well as with the CNP community. We expect that this will lead to novel insights on how to characterise, interpret and model variability in biological systems.

List of Speakers:

ALEXANDRE POUGET (University of Geneva)
ALFONSO RENART (CNP)
ASOHAN AMARASINGHAM (City College of New York)
BJOERN BREMBS (Universität Regensburg)
JORDI GARCIA-OJALVO (Universitat Pompeu Fabra)
SARAH WOOLLEY (McGill University)
TONY BELL (University of California, Berkeley)
ZACHARY MAINEN (CNP)

HOMOLOGY IN NEUROETHOLOGY

26-28/11/2014
Organiser: Alex Gomez-Marin (CNP)
Administrative Coordination: Tânia Li Chen, Alexandra Piedade

The aim of the course is to explore the notion of homology in biology, in particular, in neural structure and neural function and in animal behaviour. In the case of anatomy, drawing homologies across taxa allows to substantiate the universality of particular forms. For instance, we can certainly speak about the femur of a frog and the femur of a mammoth, and it is not mere similarity in shape or pure convention that allows us to draw such useful and insightful relationships. Building from genetics, developmental and evolutionary biology, we will explore whether, why and how it makes sense to call two circuits homologous, a computation canonical, or a behaviour primitive. We ultimately search for neural and behavioural universals amid the fascinating biological multiplicity. Thus, our efforts will be towards providing a forum for cross-talk between experts (in a language and atmosphere that is fruitful for students and non-expert scientists too) in different fields to critically evaluate some of the commonly held perspectives on the plausibility of establishing similarities, analogies and homologies in neuroscience.

List of speakers:

DAVID MOORE (Pitzer College & Claremont Graduate University, USA)
FRANK HIRTH (King's College London)
GABY MAIMON (The Rockefeller University)
ILAN GOLANI (Tel Aviv University)
FRANCESCO LACQUANITI (University of Rome Tor Vergata)

ADVANCED COURSES AND PROGRAMMES

ADVANCED BEHVAVIOUR TECHNOLOGY (SUMMER SCHOOL)

21-25/07/2014

Organisers: Adam Kampff (CNP), Michael Dickinson (University of Washington, USA), Zachary Mainen (CNP), Marta Moita (CNP), Elena Dreosti (University College London, UK).

Administrative Coordination: Tânia Li Chen, Alexandra Piedade

This course introduced the fundamental techniques of "behaviour for neuroscientists". It covered different technical skills (programming, electronics (sensors/actuators), video acquisition and analysis, animal training, closed-loop control, and virtual reality) applied to different neuroscience model organisms (zebrafish, rodents, flies, and humans). However, the course was entirely "hands-on" and requires no specific technical or neuroscience background.

HARVARD-CHAMPALIMAUD UNDERGRADUATE RESEARCH PROGRAMME

24/06/2014 – 24/08/2014

Coordinators: Adam Kampff (CNP), Inbal Israely (CNP), Ryan Draft (Harvard)

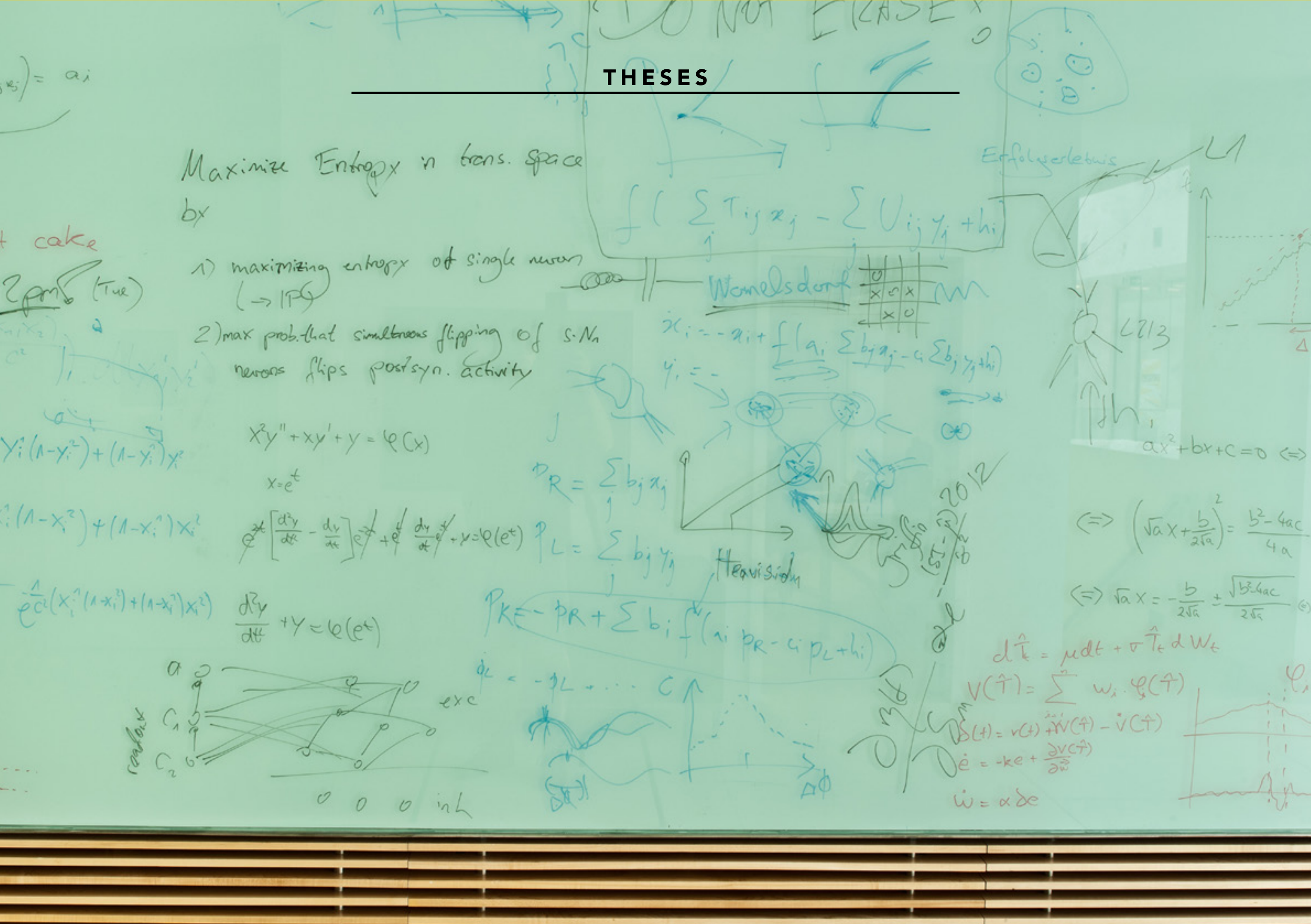
Adminstrative Assistance: Tânia Li-Chen

During the months of June to August, the Harvard-Champalimaud Undergraduate Research Programme took place at the CCU. This programme began in 2012, as a collaborative project with Harvard University, and is currently running for its fifth consecutive year. An average of 5 students from international programmes, including Harvard University, are exposed to a variety of neuroscience techniques during their internship, while working on an independent project for 10 weeks. At the end of their internship, the students present their work to the CNP community.

CAJAL ADVANCED NEUROSCIENCE TRAINING PROGRAMME

In 2014, the CNP, together with the University of Bordeaux in France, was selected to organise the CAJAL Advanced Neuroscience Training Programme, an initiative of the Federation of European Neuroscience Societies (FENS) in partnership with the International Brain Research Organization (IBRO). The CAJAL Advanced Neuroscience Training Programme offers intensive hands-on training in state-of-the-art neuroscience research, instructed by leading scientists from the field. Four courses are expected to take place in 2015, two of which will be held at Champalimaud Centre for the Unknown, and the other two at the University of Bordeaux.

THESES


DO NOT ERASE
Maximize Entropy in trans. space
bx
1) maximizing entropy of single neuron
2) max prob. that simultaneous flipping of s. N. neurons flips postsyn. activity
Womelsdorf
cake
Heaviside
2012

Lab of Megan Carey

MSc Thesis Awarded to
TATIANA SILVA
in December, 2014.

Synaptic Plasticity in Cerebellar-dependent Learning: the Role of Endocannabinoids
University of Coimbra, Portugal.

Lab of Christian Machens

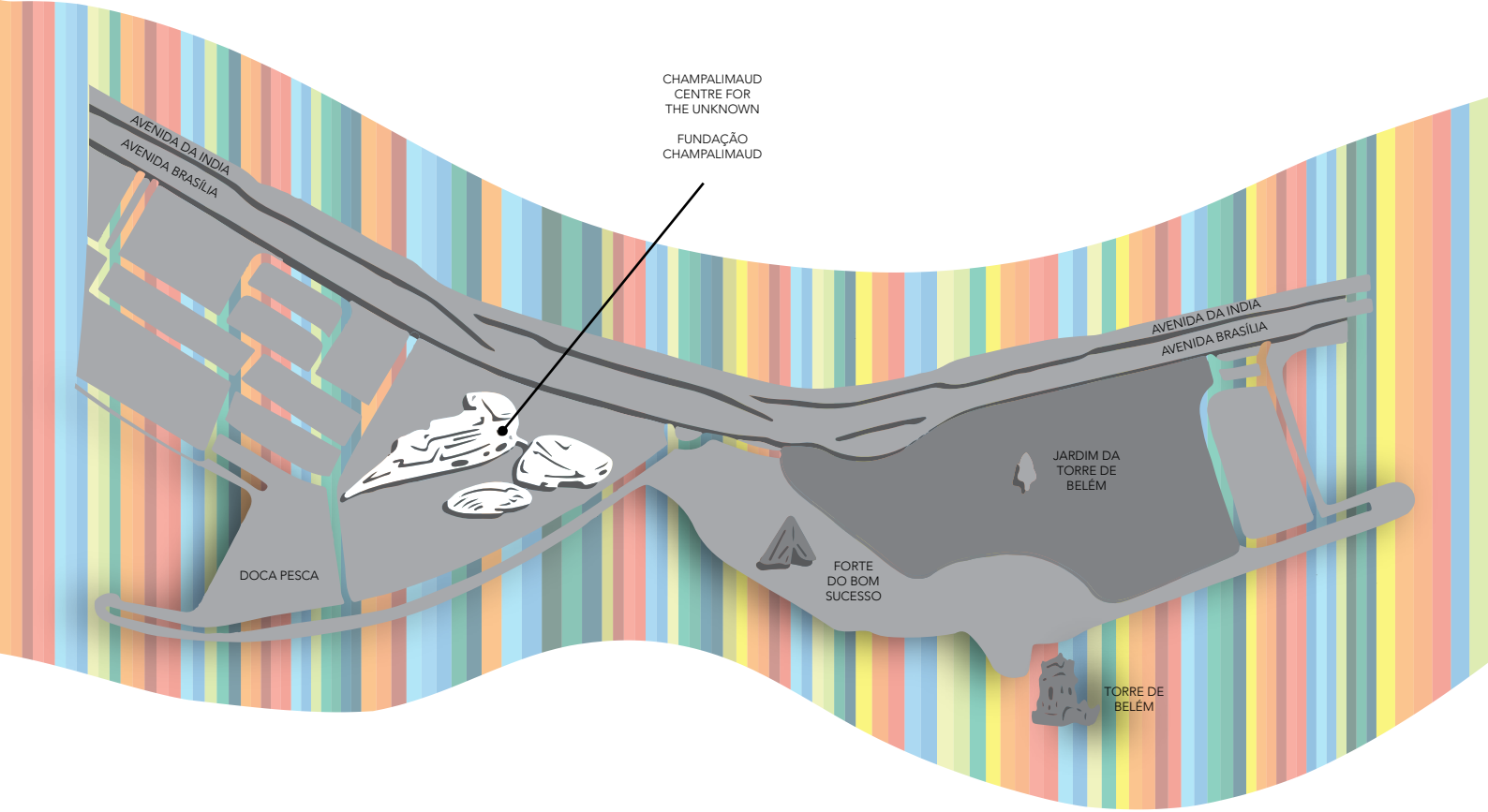
PhD Thesis Awarded to
WIELAND BRENDEL
in October, 2014.

On the Demixing and self-organized Formation of Neural Population Responses.
Ecole doctorale cerveau cognition comportement (ED3C)
Paris, France.

Lab of Gonzalo de Polavieja

MSc Thesis awarded to
FRANCISCO ROMERO
in June, 2014.

A goal programming methodology to catalogue consensus decisions
Universidad Politécnica de Madrid



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EVERYONE IN CNP
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The design of the 2014 CNP Annual Report is based on the concept of Mood Maps, particularly on the work of the Portuguese artist Luís Giestas.

In our adaptation of this concept, different events are colour-mapped as they occur in time throughout the year,creating a colourful landscape that conveys data about the CNP's annual activities. To construct our Mood Maps, we used information related to the different chapters of the annual report, where each chapter was assigned a colour-code, which is applied consistently throughout the report.

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