CNP

CHAMPALIMAUD NEUROSCIENCE PROGRAMME

2013 ANNUAL REPORT

Champalimaud Foundation

CNP

CHAMPALIMAUD
NEUROSCIENCE
PROGRAMME

2013

ANNUAL REPORT

Champalimaud
Foundation

FOREWORD

MEETING THE CHALLENGES

FOLLOWING OUR VISION

WORDS FROM THE DIRECTOR

Sometimes, like this,
I am connected to the universe.

I close my eyes and I am drenched
in a shower of shimmering future glimpses.

Aim high and not look down we must.

Immortality and more are ours for the asking,
should we dare.

Poised between dark and light,
suffocating and rejoicing;
it is a choice we make.

Running, gasping, heaving
to catch our breath,
exhausted
by the rush of bling
we pour down our minds.

But knowledge and cooperation are our origins
and perchance our destiny.

Any power, any unknown
is good and bad in equal measure.
The mesure is the process
by which it is wrought.

That will be through the pursuit of belief
and the revocation of the same.

The recursive sieve of witchcraft
we denominate science:
we are not 'like' priests.
We are all holy ones,
wielding ever mutating spells
to conjure from the ether
ineffable invisible alms.

The church of science
owes an untold debt
to the trust of unsung believers.

Abuse this trust and we shall merit
all the fury that is drawn;
the inquisitioners' revenge awaits.

But keep the trust, walk and think
with always and ever patent eyes, and minds, and hearts,
and the world will continue to twirl,
a never ceasing kaleidoscopic confetti
of glittering, spinning dreams.

Zachary Mainen
Director, Champalimaud Neuroscience Programme

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 15 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 disease. 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.

Board of Directors:
João Silveira Botelho (left), **Leonor Beleza** (middle) and **António Horta-Osório** (right).

CHAMPALIMAUD FOUNDATION

Board of Directors

LEONOR BELEZA (PRESIDENT)

JOÃO SILVEIRA BOTELHO

ANTÓNIO HORTA-OSÓRIO

General Council

DANIEL PROENÇA DE CARVALHO (CHAIRMAN)

FERNANDO HENRIQUE CARDOSO

SIMONE VEIL

ANÍBAL CAVACO SILVA (EMERITUS)

ANTÓNIO ALMEIDA SANTOS

ANTÓNIO COUTINHO

ANTÓNIO DAMÁSIO

ANTÓNIO TRAVASSOS

CARLOS EUGÉNIO CORRÊA DA SILVA

JOÃO RAPOSO MAGALHÃES

ANTÓNIO BORGES

PEDRO D'ABREU LOUREIRO

Scientific Committee

JAMES WATSON (CHAIRMAN)

ALAN ASHWORTH

MARK BEAR

MARIA BLASCO

RONALD BLASBERG

BARRY DICKSON

PAUL MARKS

J. ANTHONY MOVSHON

KEITH PETERS

MARTIN RAFF

SUSUMU TONEGAWA

CHAMPALIMAUD CENTRE FOR THE UNKNOWN

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

THE CHAMPALIMAUD NEUROSCIENCE PROGRAMME

AIMS TO UNRAVEL THE NEURAL BASIS OF BEHAVIOUR

THE CHAMPALIMAUD NEUROSCIENCE PROGRAMME

"THE AIM OF ART IS TO REPRESENT NOT THE OUTWARD APPEARANCE OF THINGS, BUT THEIR INWARD SIGNIFICANCE."

Aristotle, (384-322 B.C.)

Through evolution, the process of life has organised matter into a myriad of interlinked forms from molecules to ecosystems. Neuroscience attempts to understand the behaviour of individual organisms within this web in terms of the structure and function of their nervous systems.

A major current challenge in neuroscience is to understand how properly functioning neural circuits support intelligent, adaptive behaviour and how the dysfunction of these circuits can be prevented. Based on work over the last century, this appears to be a problem ripe for progress but which may demand a paradigm shift in current thinking and approaches.

The Champalimaud Neuroscience Programme (CNP) seeks to facilitate the quest of scientists to forge new links between nervous system function and behaviour. The scientific goals of the programme are represented not by a particular field within neuroscience, but by the full intellectual scope of the scientists of the programme. The aspiration of the CNP as an organisation is to help those scientists to reach their full creative potential and to promote collective achievements beyond those reachable by individual scientists or laboratory groups. This is a challenge that we believe demands that we examine, question and attempt to improve the scientific process itself. Toward this end, the vision of the CNP seeks to promote an institutional culture based on the following aims:

> To maximise cooperation without sacrificing independence and diversity of thought;

> To foster good life quality, recognising that well-being and productivity go hand in hand;

> To be a hub for scientific interaction, engaging our peers in productive exchange rather than competition;

> To share our knowledge not only within the scientific community but with the community at large;

> To continually renew the organisation itself, nurturing new scientific approaches and the organisational structures that encourage them.

If we are successful, the legacy of the CNP will be not only advances in scientific knowledge but advances in the scientific process itself.

ORGANISATION OF THE CNP

CNP DIRECTOR

PRINCIPAL INVESTIGATORS

ZACHARY MAINEN

INDP DIRECTOR

ALFONSO RENART

ADMINISTRATIVE COORDINATOR

PHILIPP TSOLAKIS

COMMUNICATION COORDINATOR

CATARINA RAMOS

MEGAN CAREY

EUGENIA CHIAPPE

RUI COSTA

INBAL ISRAELY

ADAM KAMPFF

SUSANA LIMA

CHRISTIAN MACHENS

ZACHARY MAINEN

MARTA MOITA

MICHAEL ORGER

JOE PATON

LEOPOLDO PETREANU

ALFONSO RENART

CARLOS RIBEIRO

MARIA LUÍSA VASCONCELOS

SCIENTIFIC ADVISORY BOARD

The Scientific Advisory Board (SAB) of the CNP is composed of internationally recognised neuroscientists who meet annually with CNP researchers whose work is scheduled for review. In this meeting the SAB provides input and advice on current and future research directions with the purpose of facilitating optimal research advances.

The SAB consists of regular members who also reside on the Scientific Committee of the Champalimaud Foundation, and additional SAB members who join on a yearly basis.

Regular SAB members

J. ANTHONY MOVSHON
Visual Neuroscience Laboratory
Centre for Neural Science
New York University
New York, USA

BARRY DICKSON
Austrian Institute of Molecular Pathology
Vienna, Austria

MARTIN RAFF
MRC Laboratory for Molecular
Cell Biology & Cell Biology Unit
University College London
London, UK

2013 SAB members

TOBIAS BONHOEFFER
Managing Director
Max Planck Institute of Neurobiology
Munich, Germany

THOMAS JESSELL
Department of Neuroscience and Department
of Biochemistry and Molecular Biophysics
Columbia University
New York, USA

CNP Annual Retreat 2013.

2013 HIGHLIGHTS

JANUARY

11th
2nd Edition of
Sciencecalifragilistic begins

MARCH

26th
Leopoldo Pteranu
awarded HFSP
Young Investigator
Grant

HFSP

13th
Zachary Mainen
at TEDx O'Porto

APRIL

4th
Ar event on Learning
& Education

MAY

22th
Ar event
on Storytelling

JUNE

18th - 22th
CNP Annual
Retreat

JULY

14th
Marta Moita receives
ERC starting grant

erc

European Research Council

SEPTEMBER

25th - 28th
Third Champalimaud
Neuroscience Symposium

OCTOBER

17th
Ar Event on Maths

24th - 25th
10th National Congress
of Portuguese Society
of Ethology

NOVEMBER

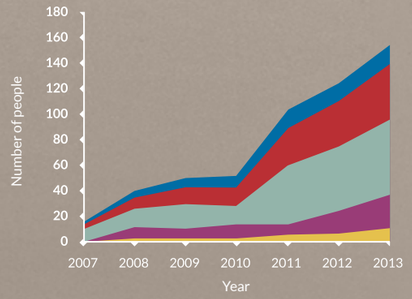
16th
Sciencecalifragilistic
at TEDx Youth in Leiria

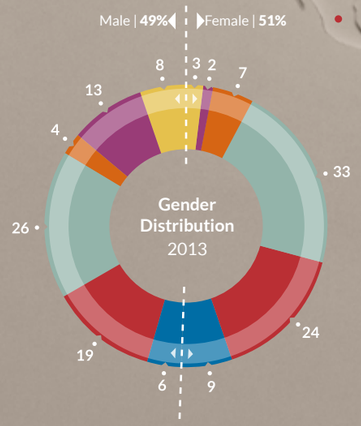
30th
Ar event on Music

GROWTH AND DIVERSITY

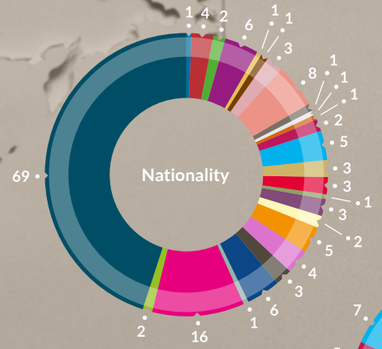
Since its establishment in 2007 until December 2013, the CNP grew to include 154 members.

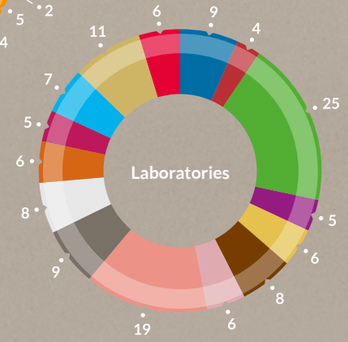
CNP Growth
2007-2013





- Principal Investigators
- Postdoctoral Researchers
- PhD Students
- Lab Technicians
- Administrative Support
- Masters Students





Nationality

- Angola
- Argentina
- Austria
- Brazil
- Colombia
- Costa Rica
- France
- Germany
- Greece
- India
- Ireland
- Israel
- Italy
- Japan
- Mexico
- Norway
- Russia
- South Africa
- Spain
- Switzerland
- Turkey
- UK
- Ukraine
- USA
- Venezuela
- Portugal

Laboratories

- Neural Circuits and Behavior
- Sensorimotor Integration
- Neurobiology of Action
- Neuronal Structure and Function
- Intelligent Systems
- Neuroethology
- Theoretical Neuroscience
- Systems Neuroscience
- Behavioral Neuroscience
- Vision to Action
- Learning
- Cortical Circuits
- Circuit Dynamics & Computation
- Behavior and Metabolism
- Innate Behavior

TO FORGE NEW LINKS

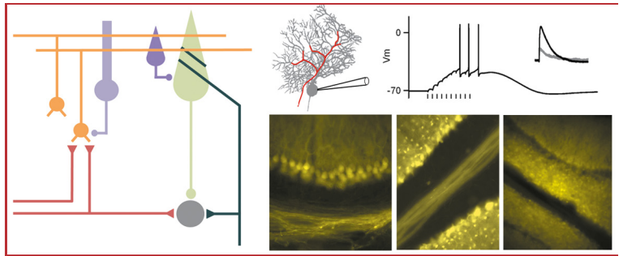
BETWEEN NERVOUS SYSTEM FUNCTION AND BEHAVIOUR

NEURAL CIRCUITS AND BEHAVIOUR

MEGAN CAREY
Principal Investigator

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 relatively simple and well understood. 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 hope to determine links between cellular function, circuit activity and behaviour.

KEY PUBLICATIONS



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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

João Fayad
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Ana Sofia Machado
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Dana Darmohray
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Tatiana Silva
University of Coimbra Masters Student

Carla Matos
Research Technician

Tracy Prichett
Research Technician

PROJECT

GRANTS - HOWARD HUGHES MEDICAL INSTITUTE (HHMI); FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E TECNOLOGIA (FCT); CHAMPALIMAUD FOUNDATION

Dissecting the role of endocannabinoids in eyeblink conditioning

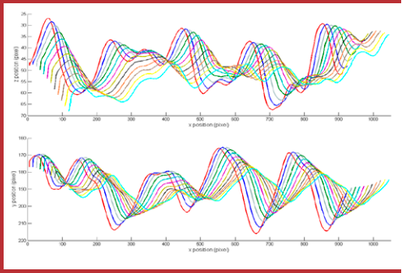
Delay eyelid conditioning is a simple form of classical conditioning that depends critically on an intact cerebellum. Multiple synaptic plasticity mechanisms within the cerebellum have been identified and proposed as cellular substrates of learning for this behaviour. One class of molecules that appears 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

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.



Tail trajectory during mouse locomotion. Tail images for a 1 sec movie were automatically detected and divided into 12 color-coded segments. Vertical (top) and side-to-side (bottom) movements are shown for each segment as the mouse walks along a glass corridor.

PROJECT

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 motorized 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 will use it in combination with genetic and electrophysiological tools to investigate the neural basis of locomotor adaptation.

SENSORIMOTOR INTEGRATION

EUGENIA CHIAPPE
Principal Investigator

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

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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

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Tomás Cruz
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Técnico Masters Student

James Bohnslav
Research Technician

PROJECT

CHAMPALIMAUD FOUNDATION

COLLABORATORS

GONÇALO LOPEZ
(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

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

GRANTS - FP7 PEOPLE (MARIE CURIE CAREER INTEGRATION GRANT); CHAMPALIMAUD FOUNDATION.

Probing neural processing during sensorimotor tasks

In simultaneous 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.

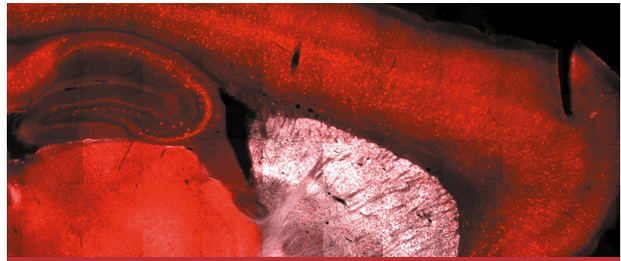
NEUROBIOLOGY OF ACTION

RUI M. COSTA
Principal Investigator

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



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.**

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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.* **Nature neurosci 12:3.**

* equal contribution

LAB MEMBERS

Cristina Afonso
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Fatuel Aguilar
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Fernando Santos
2008 INDP PhD Student

Ana Mafalda Vicente
2008 INDP PhD Student

Sevinç Mutlu
2009 INDP PhD Student

Eduardo Dias-Ferreira
PDBEB-Coimbra PhD Student

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Cátia Feliciano
Postdoctoral Researcher

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Wellcome Trust Fellow

Lauren McElvain
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Alejandro Gomez-Marin
Postdoctoral Researcher

Joaquim Alves da Silva
PFMA-Gulbenkian PhD student

Ana Castro, MD
PFMA-Gulbenkian PhD student

Mariana Correia
Research Technician

Ana Maria Vaz
Research Technician

Vivek Athalye
Visiting Student, EECS Graduate Program, Berkley

CLINICAL RESEARCH FELLOWS

Ana Fernandes, PhD
Postdoctoral Researcher

Marta Camacho
Clinical Research Fellow

Albino Maia, MD, PhD
Clinical Research Fellow

PROJECT

EUROPEAN RESEARCH COUNCIL (ERC); EU FP7 MARIE CURIE INTEGRATION GRANT; 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

EUROPEAN RESEARCH COUNCIL (ERC), FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT), CHAMPALIMAUD FOUNDATION (PORTUGAL)

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

CHAMPALIMAUD FOUNDATION

Neural mechanisms underlying the generation of novel actions

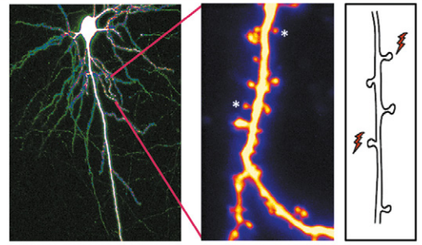
This project aims to understand how new self-initiated actions are generated and how this ability is hampered in Parkinson´s disease. We have developed a new methodology to classify in an unbiased manner different behavioural and neural states.

NEURONAL STRUCTURE AND FUNCTION

INBAL ISRAELY
Principal Investigator

We are interested in understanding how experience can lead to specific structural changes in neurons, and how such changes affect connectivity within neural circuits. The diverse patterns of activity that a neuron receives are physically stored at the level of individual neuronal connections, yet we know little about how this is accomplished. Can long lasting depression lead to the shrinkage or even elimination of unwanted inputs? What types of changes in efficacy and structure take place following complex patterns of naturally occurring activity? Several mental retardation disorders in humans are characterised by abnormal spine morphology. Studying neurons from these animal models may further our understanding of the relationship between structure and function, and how this contributes to normal cognitive function. Thus, we combine molecular and genetic tools with imaging and electrophysiological methodologies, to determine how information is physically stored in the brain.

KEY PUBLICATIONS



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**.

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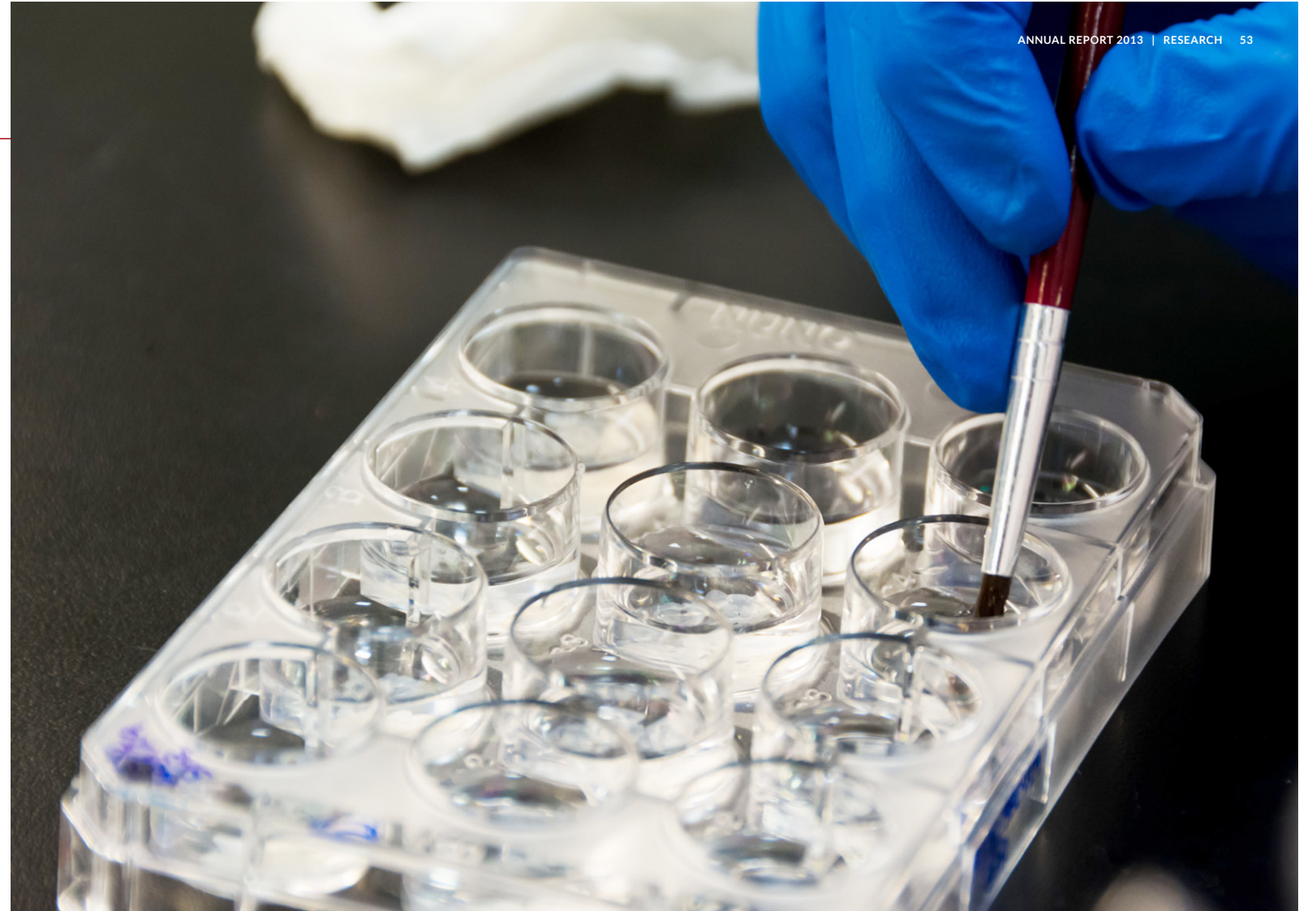


PROJECT

GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT); FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E TECNOLOGIA (FCT); CHAMPALIMAUD FOUNDATION (PORTUGAL)

Dendritic synapse organisation via protein synthesis-dependent synaptic plasticity

Neural connectivity may be shaped by activity, leading co-active synapses to become clustered on the same dendritic branch. We aim to determine what are the mechanisms by which this physical organisation of inputs may be achieved. As protein synthesis dependent plasticity can facilitate long lasting changes between neighboring spines, this may contribute to such a process. Using 2-photon imaging and glutamate uncaging, we examine how activity at spines leads to structural changes, and whether such changes give rise to computational units. Progress in 2013: We are testing what are the structural correlates of various forms of long lasting activity at nearby spines, through glutamate uncaging, in order to determine whether clustering can be induced. We are establishing paradigms for following such structural changes over prolonged periods, and have thus far imaged the same inputs for up to 24 hours. We wish to extend this to the time scale of several weeks.

PROJECT

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 different forms of long lasting synaptic depression at dendritic spines. In particular, we are interested in exploring synaptic depression that depends on new protein synthesis. Additionally, we will probe whether new proteins serve to constrain plasticity at multiple spines similarly to the case for long term potentiation. Progress in 2013: We have investigated the structural correlates of protein synthesis dependent long-term depression (LTD) mediated by metabotropic glutamate receptors (mGluRs) in hippocampal pyramidal neurons and find that it leads to robust and long lasting spine shrinkage and elimination, that is independent of intial spine size. These effects depend on group I mGluRs, require protein synthesis, and activity. These findings were published in 2013.

PROJECT

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. We aim to mimic the varied input patterns observed in vivo, with glutamate uncaging at individual spines, in order to determine the structural and plasticity correlates of such activity. Also, we will investigate how this activity interacts when multiple synapses within a dendritic branch are stimulated. We use this information to model neuronal information processing to understand the learning rules which govern synaptic weight changes. Progress in 2013: Thus far, we have validated an uncaging paradigm for the induction of spike timing dependent plasticity at synapses in slice cultures. Also, together with Tom McHugh, we have recorded in vivo activity from CA3 neurons in freely behaving mice. These data are being analysed to design in vitro uncaging paradigms.

PROJECT

GRANTS - TUBITAK (TO DEVRIM UNAY, ISRAELY AS COLLABORATOR)

COLLABORATORS

DERVIM ÜNAY, BAHCESEHIR (University Istanbul, Turkey)

Semi-automatic dendritic spine detection and analysis

In addition to changes in the volume of the spine head following the induction of plasticity, many other changes in spine structure have been observed, such as changes in spine neck length, outgrowth of the neck, etc. Such changes are difficult to quantify with existing methods, and therefore we are developing automated data analysis tools for handling both the large data sets and the many variables to be analysed. 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. Progress in 2013: We have developed a semi-automated, multi-level, region based segmentation method to detect dendritic spines from two-photon microscopy images. Identified structures in two-photon images of dendritic spines are used to train the segmentation algorithm. A broader automated dendritic spine detection and analysis framework is underway. A journal article about this toolbox is in preparation.

INTELLIGENT SYSTEMS

ADAM KAMPFF
Principal Investigator

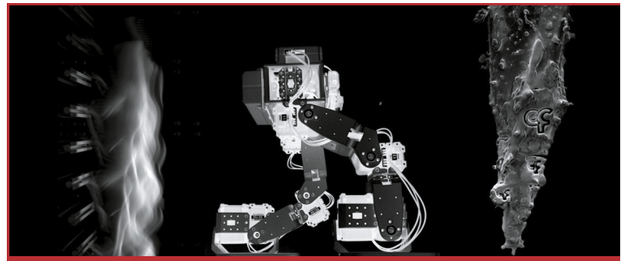
The goal of the Intelligent Systems Lab is to understand how a nervous system constructs a model of the world. How do brains learn about the statistics of their environment? How is this information encoded in networks and used to control intelligent behaviour? To answer these fundamental questions, two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



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

PROJECT

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)

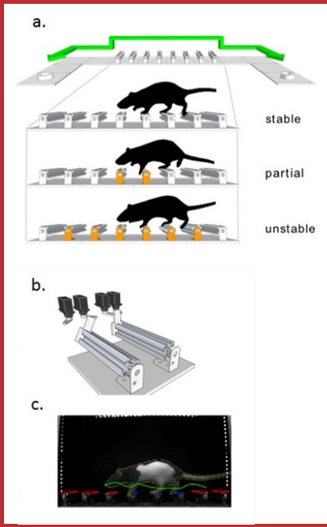
Modern techniques in experimental neuroscience require the combination of many different technologies and software algorithms for data acquisition, analysis and instrument control. The development of such systems is often a time-consuming and challenging task. We present Bonsai, an open-source framework 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.

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

PROJECT

GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT), FP7; FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT); CHAMPALIMAUD FOUNDATION

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



DYNAMIC OBSTACLE COURSE FOR RATS.
a. Assay schematic, a series of elevated obstacles separated water reward ports; **b.** A servo-motor clamping mechanism that allowed computer-control of each obstacle's rotational stability; **c.** Frame from the high-speed camera, overlaying the movement parameters tracked and quantified offline.

COLLABORATORS

JOE PATON
(Champalimaud Neuroscience Programme)

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 progvrammable 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 behaviour 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.

Nanostructuring strategies for improving the performance of neural electrodes

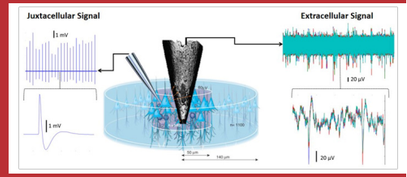
PROJECT

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)

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,



SIMULTANEOUS EXTRA - AND JUXTACELLULAR RECORDING.
An overview of a dual-technique recording experiment with a cell-attached micropipette (juxtacellular) and a glass tetrode (extracellular) positioned to within ~50 µm of each other. The signal from the isolated neuron is expected to be visible to an extracellular electrode within a range ~100 µm, 3-D schematic adapted from Buzsáki, 2004

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.

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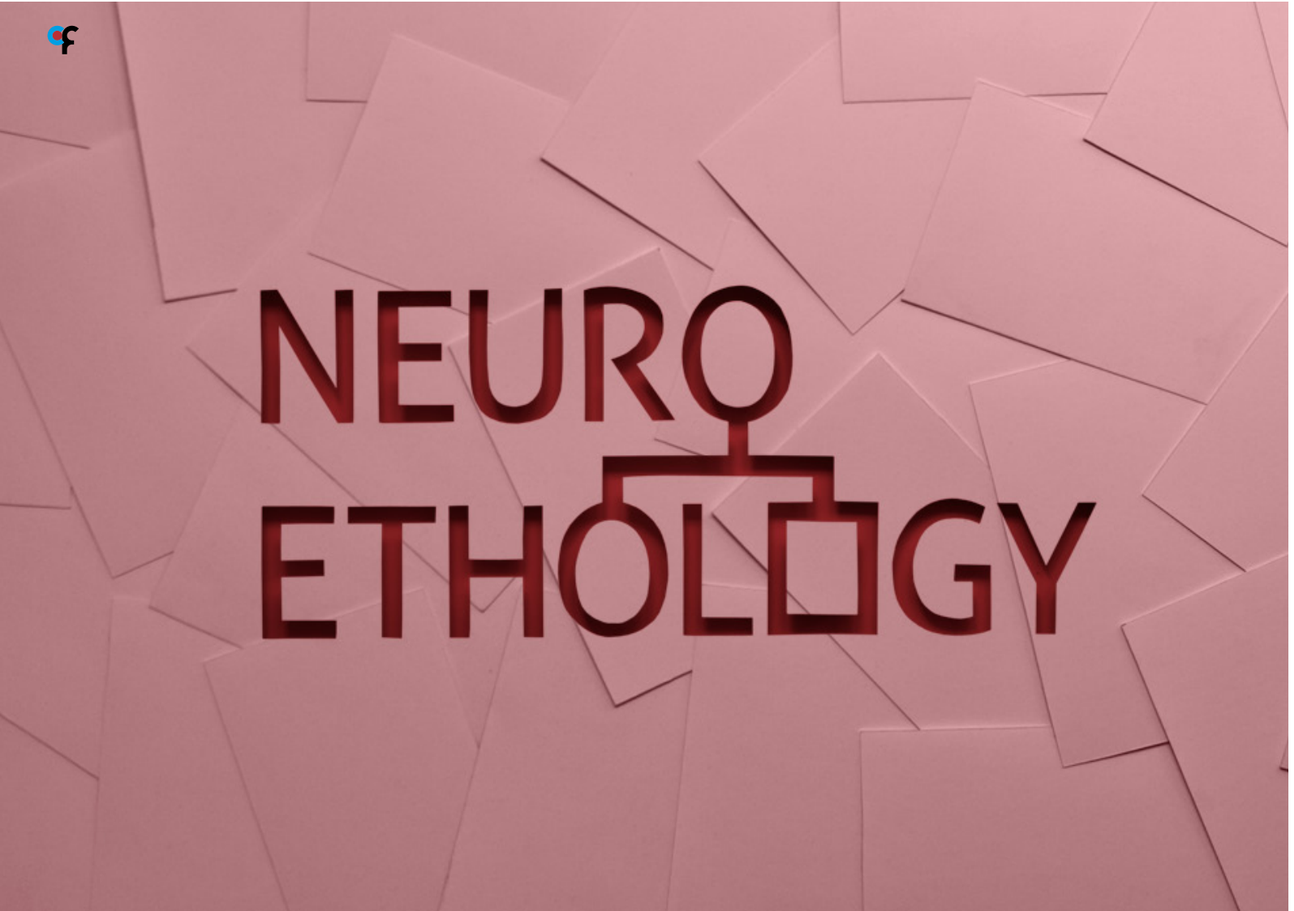
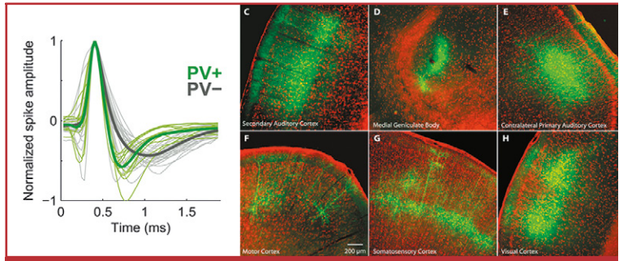


SUSANA LIMA

Principal Investigator

The main goal of our laboratory is to gain mechanistic insights into the neuronal processes underlying fundamental behaviours in females: 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



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PROJECT

GRANTS - FP7- PEOPLE (MARIE CURIE); 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 and the chooser's preferences, (which are shaped by learning, early life experience and by the evolutionary history of its own species). To better understand the interaction between these factors, we studied mate choice in the female house mouse, Mus musculus musculus, which show an assortative preference for males of their own subspecies over males of the sibling species Mus musculus domesticus. This behaviour is ecologically relevant, but its origins are not understood. In recent experiments, we show that female mouse mate preference has a hierarchical dependence on early postnatal life experience and the order of males encountered as an adult. Whereas females raised in their normal musculus environment display a robust homosubspecific preference, females fostered in a domesticus family prefer the first male encountered, regardless of subspecies. Thus, early life experience of musculus females, when and only when concordant with genetic self-identify, overrides sampling order effects, ensuring robust assortative choice.

PROJECT

FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E 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. Behavioural results showed that there was no clear effect of the estrous cycle on behaviour. 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, although female mice show similar behaviours during initial social interactions, the VMHvl neurons have already become more responsive to males during the sexually receptive phase.

PROJECT

FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E TECNOLOGIA (FCT); CHAMPALIMAUD FOUNDATION

Prolactin and its role on sexual behaviour

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 regardibg the function of this surge. We have recently discovered that prolactin is also released in male mice after ejaculation. Hence, we are currently developing methods to artificially control prolactin release in vivo and test its role directly on sexual behaviour.

Imprinting in mice

PROJECT

GRANTS - FP7 - PEOPLE (MARIE CURIE); CHAMPALIMAUD FOUNDATION

Sexual selection is an important evolutionary agent that has repercussions in the morphology, behaviour, mating system and life history evolution of species, and it may even influence speciation as well as extinction. With this project we aim at clarifying some of the pre-zygotic divergence mechanisms that could be behind the low genetic flow across two very similar subspecies: Mus musculus musculus and Mus musculus domesticus. Because olfaction is the major communication highway in newborn rodents we will explore the possibility that an early olfactory experience might play an important role in choosing a sexual partner later in life. Hence, using both behavioural testing and immunohistochemistry techniques in mice we will initiate the study to unravel the neuronal circuitry behind this early life learning.

5HT and male sexual behaviour

PROJECT

FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E TECNOLOGIA (FCT); CHAMPALIMAUD FOUNDATION

COLLABORATORS

ZACHARY MAINEN, (Champalimaud Neuroscience Programme)

5HT has been implicated in a variety of behavioural phenomena, from sleep, to feeding, but also sexual behaviour. Using optogenetic tools which give us high temporal precision for neuronal manipulation we are investigating the impact of 5HT release in male sexual behaviour.

Social transmission of mate choice

PROJECT

FELLOWSHIPS – FUNDAÇÃO PARA A CIÊNCIA E TECNOLOGIA (FCT); CHAMPALIMAUD FOUNDATION

COLLABORATORS

MARTA MOITA (Champalimaud Neuroscience Programme, Portugal)

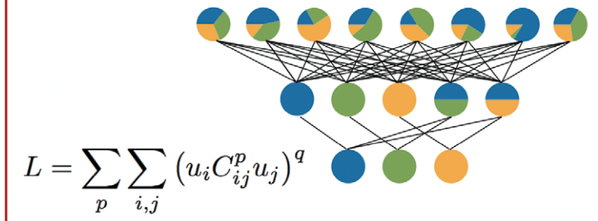
Animals can obtain information and learn about the world either by self-experience or by using information provided by others. These are two distinct strategies that have different costs and benefits associated, and which have been observed in humans and several other animal species. Rodents are social organisms able to collect and capitalize on the information provided by conspecifics for their own decision-making and learning processes as it has been shown in transmission of food preference and fear, for example. Using mice as model system, we show that females can bias their decision depending on information received from their siblings.

TheOre(t)ical neuro=(sc1ence)

CHRISTIAN MACHENS

Principal Investigator

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 summarize 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.



$$L = \sum_p \sum_{i,j} \left(u_i C_{ij}^p u_j\right)^q$$

KEY PUBLICATIONS

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

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Spiking network dynamics and tuning curves

PROJECT

FELLOWSHIPS - ENS PARIS

COLLABORATORS

SOPHIE DENEVE
(Ecole Normale Superieure, Paris)

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.

Robustness of networks to neuron death

PROJECT

FELLOWSHIPS - ENS PARIS.

COLLABORATORS

SOPHIE DENEVE
(Ecole Normale Superieure, Paris)

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.

Analysis of neural population data

PROJECT

FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E TECNOLOGIA (FCT);
CHAMPALIMAUD FOUNDATION

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NAOSHIGE UCHIDA
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ADAM KEPECS
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CLAUDIA FEIERSTEIN
(Champalimaud Neuroscience Programme, Portugal);
ZACHARY MAINEN
(Champalimaud Neuroscience Programme, Portugal)

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 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

FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E TECNOLOGIA (FCT), ENS PARIS; CHAMPALIMAUD FOUNDATION.

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 stabilize 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.

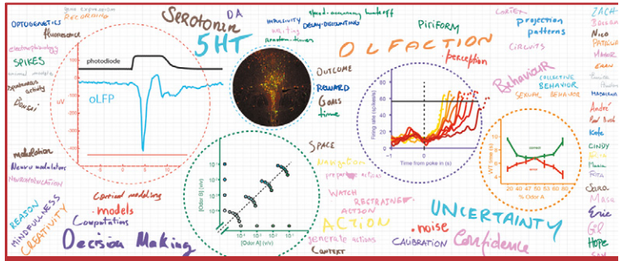
SYSTEMS NEUROSCIENCE

ZACHARY MAINEN
Principal Investigator

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. Projects in the lab are wide-ranging and continually evolving. Current topics include:

1. Olfactory sensory decision-making.
2. The function of the serotonin system.
3. The role of uncertainty in brain function and behaviour.
4. The neural dynamics of choice.

KEY PUBLICATIONS



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PROJECT

GRANTS - EUROPEAN RESEARCH COUNCIL (ERC), EUROPEAN COMMISSION;
FELLOWSHIPS - HELEN HAY WHITNEY FOUNDATION (HHWF)

COLLABORATORS

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(Champalimaud Neuroscience Programme, Portugal)

Optogenetic identification and control of serotonin neurons in behaving animals

Serotonin (5-HT) is an important neurotransmitter implicated in a wide variety of physiological functions and psychopathologies, but whose function is not well understood. Critically, very little is known about the activity of serotonin-releasing neurons in the brain. This problem is greatly exacerbated by the difficulty in identifying these neurons during physiological recordings. To address these problems, we will develop and validate optogenetic methods that target 5-HT neurons, gaining access to record and perturb this system optically with high temporal and genetic specificity. We will combine these tools with behavioural analysis and electrophysiological recordings toward understanding the role of 5-HT in adaptive behaviour. Our aims are to use these approaches to stimulate, silence and monitor 5-HT function in the context of spontaneous behaviours, value-related decision-making, sensorimotor function and behavioural timing. Progress in 2013: Recently, we developed a new methodology that allows us to calibrate expression levels of ChR2 and placement of fiberoptic delivery in the DRN in vivo as well as a bulk imaging system to detect 5-HT neuron activity using genetically-encoded calcium sensors in behaving animals. With respect to sensory function, we have found that 5-HT stimulation inhibits spontaneous and odour-evoked activity in the piriform cortex and also decreases behavioural sensitivity to nociceptive stimuli (manuscript in preparation). In the motor system, we have examined the effect of 5-HT stimulation on locomotion in the home cage and open field and performed detailed characterisation of the effects on mice performing a water-reinforced nose poke and an impulse control (waiting) task. Preliminary results suggest inhibitory effects on these behaviours. We have also begun testing the impact of 5-HT activation in the context of sexual behaviour, in which we hypothesized an enhancement of satiety. Finally, we have begun to implement methods for expressing ChR2 and other reporters in a pathway and cell-type specific or an activity-dependent manner.

PROJECT

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 an important and difficult problem solved by the nervous system. According to theoretical accounts, object recognition can be understood as a process of probabilistic inference. Under this hypothesis, complex stimuli are represented using a probabilistic population code. To link these normative ideas to specific neurophysiological and behavioural predictions, we are formalising them using computational models. Experimentally, our primary goal is to monitor and perturb object representations in the functioning, computing brain. To this end, we deploy olfactory psychophysical tasks in rats, which formalise complex real-world problems. By combining such 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. Progress in 2013: In recent work, we demonstrated large differences in speed-accuracy trade-offs (SATs) between odour detection and categorisation,

(manuscript submitted). We developed a computational model of these tasks, which can be fit to the data, and which has allowed us to formalise the hypothesis that SAT is problem-specific and suggesting that the locus of performance-limiting noise is a critical variable (manuscript in preparation). The model postulates, that categorization decisions are limited by trial-to-trial variability in the decision boundary, a prediction that was independently verified by conditional trial analysis (manuscript in preparation). Finally, we began the development of a task for testing probabilistic inference using spatial contextual cues on an olfactory sensory identification problem.

Action selection and action timing in the premotor cortex

PROJECT

GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT);
CHAMPALIMAUD FOUNDATION (CF

COLLABORATORS

HANAN SHTEINGART,
YONATAN LOWENSTEIN
(Hebrew University, Israel)

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. Finally, we will apply optogenetic techniques to perturb specific circuits and observe the impact on behaviour. Progress in 2013: We identified two populations of neurons in the secondary motor cortex (M2) predictive of waiting time, one with "ramping"-to-threshold activity and the other with "transient" activity. Furthermore, we find that M2 inactivation dramatically impairs execution of this task sequence, while medial prefrontal cortex (mPFC) inactivation produces a selective prolongation of waiting times. mPFC neurons carry state-specific signals but do not predict waiting times. These data suggest a model in which "transient" neuron activity is integrated by circuits reflected by "ramping" neurons.

Evaluating the reliability of knowledge: neural mechanisms of confidence estimation

PROJECT

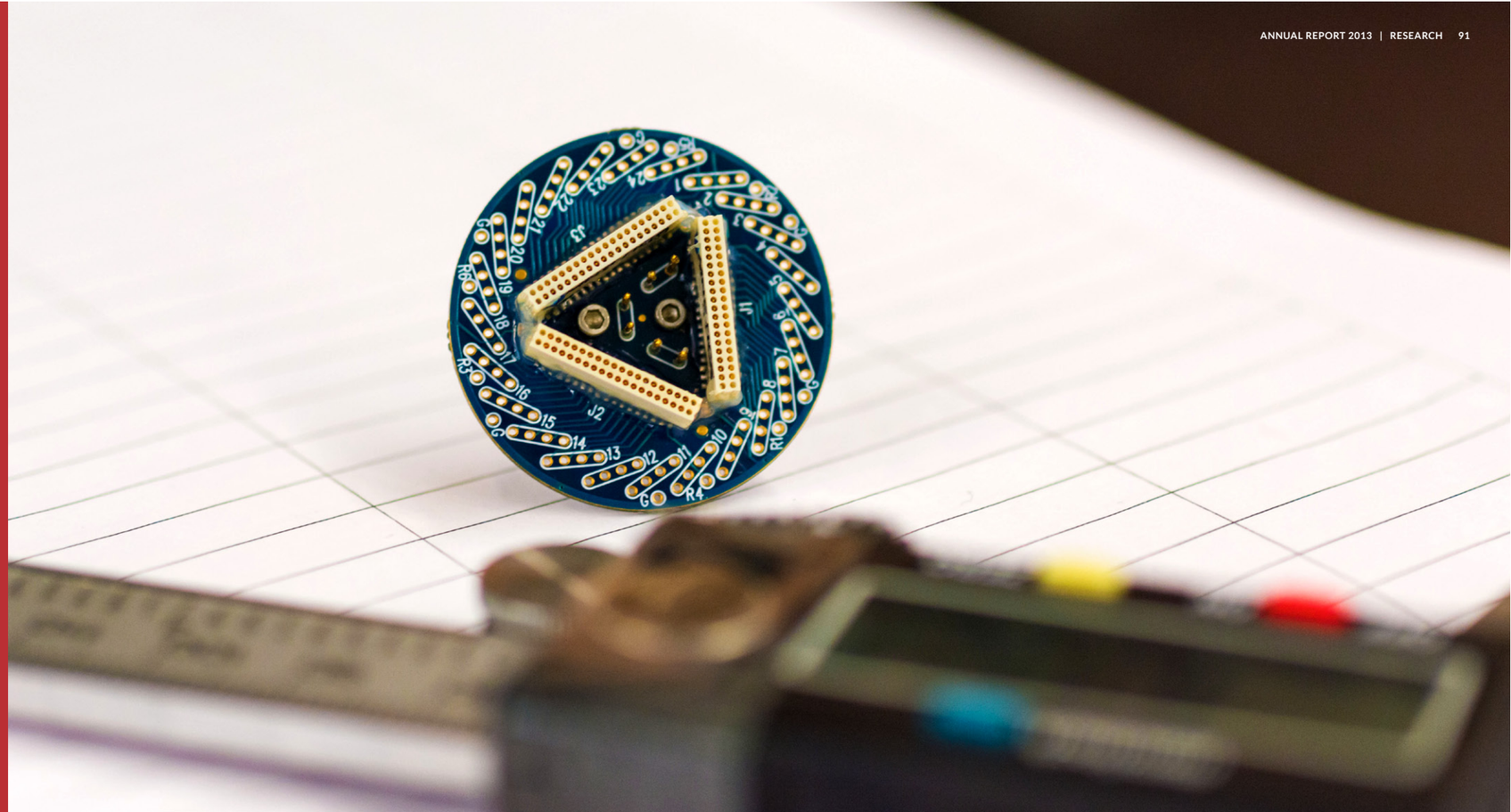
CHAMPALIMAUD FOUNDATION (CF),
FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)

COLLABORATORS

ADAM KEPECS,
(Cold Spring Harbor Laboratory, USA)

Humans and other animals must often make decisions on the basis of imperfect evidence. What is the neural basis for such judgments? How does the brain compute confidence estimates about predictions, memories and judgments? Previously, we found that a population of neurons in the orbitofrontal cortex (OFC) tracks the confidence in decision outcomes. We are seeking to extend these observations by testing whether confidence-related neural activity in the OFC is causally related to confidence judgments. We are also addressing how the uncertainty about a stimulus in the course of decision-making is computed in olfactory sensory cortex. We are currently establishing similar confidence-reporting tasks in humans and testing them in a range of behaviours.

These experiments will give us further insights into the nature of the neural processes underlying confidence estimation. Progress in 2013: An important issue we wish to address is how confidence is “calibrated” such that subjects have an accurate estimate of their performance. These experiments will give us further insights into the nature of the neural processes underlying confidence estimation. Recently, in rats, we found that inactivation of the rat orbitofrontal cortex impairs confidence reporting but not choice behaviour suggesting that confidence-related neural activity in the OFC is causally related to confidence judgments (manuscript under review). We used chronic multi-electrode recordings to assay neural ensemble function in the olfactory tubercule of rats performing a confidence reporting task together with a reward value manipulation (study in progress). In humans, we tested confidence reporting tasks similar to those we deployed in rats under several different psychophysical paradigms. We aim to use manipulations to test whether there are task-general as well as task-specific mechanisms for confidence calibration.



BEHAVIOURAL NEUROSCIENCE

MARTA MOITA
Principal Investigator

We are interested in understanding the neural mechanisms underlying behavioural plasticity using a combination of behavioural, pharmacological or optogenetic tools. In particular, we are studying how prior experience and how social interactions shape behaviour. Living in social groups has an adaptive value for a number of reasons. We focus on defence mechanisms in the context of a social environment and social foraging. In the first case, we study how rats use defence behaviours of con-specifics, such as freezing, as alarm cues. The neural mechanisms by which animals use social information to detect impending danger are largely unknown. In addition, we study social buffering, i.e. how social interactions mitigate fear, which is thought to underlie in part a preference to be close to con-specifics. In the second case, we study prosocial behaviour of rats in using food foraging tasks.

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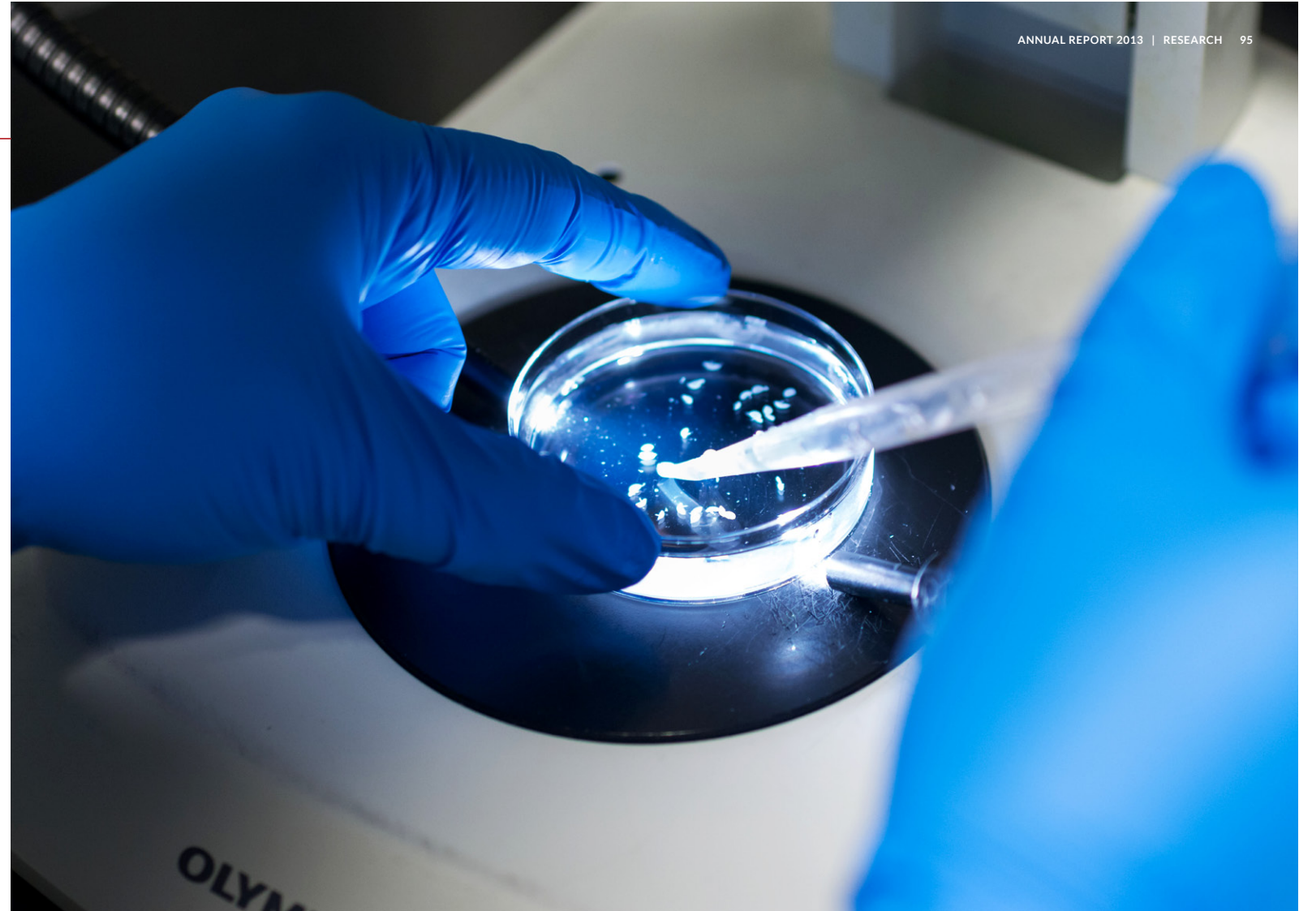


PROJECT

FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)

Neural mechanisms of social transmission of fear in rats

This project aims at investigating the mechanisms underlying social transmission of fear (STF) 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. 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. Progress in 2013: To study the mechanisms of silence detection we have established a protocol to silence neurons in a temporally precise manner using optogenetics. We are currently focusing on the lateral amygdala. Finally, through a series of experiments we found that stress is not sufficient to drive observational freezing and that freezing in association with shock is important for this process.

PROJECT

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, of which the neural mechanisms 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. Progress in 2013: 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 amygdala.

PROJECT

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*

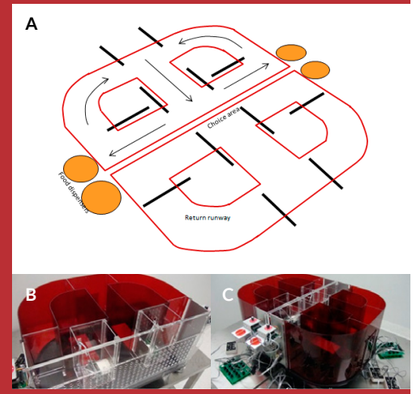
To address the question of the neural mechanisms of social defence responses we propose to use a model system that is both amenable to the search for the neural mechanism of behaviour, while at the same time allowing the study of the behaviour of large groups of individuals. The fruit fly is the ideal 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.

Cooperation in social dilemmas in rats

Game theory has constituted a powerful tool in the study of the mechanisms of reciprocity. We are using the Stag Hunt game, a coordination game in which the best thing to do is the same as the other subject, and where the choice of cooperating entails a higher risk then defecting. 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. Progress in 2013: We have started to run this game as a simultaneous choice game between freely choosing agents. We found that rats coordinated most of the time, but were equally likely to cooperate or defect. Interestingly, we found that the rat that chose first was more likely to cooperate after a coordination trial than after an anti-coordination trial.

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. Progress in 2013: 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 both the display of food-seeking behaviour (poking in a nose-port) and the delivery of rewards are necessary to drive prosocial choices.



BEHAVIOURAL SET UP FOR THE STUDY OF PROSOCIAL BEHAVIOUR IN RATS.
Our behavioural apparatus consists of two identical fully automated individual T-mazes **(A-C)** that can be placed together for the Prosocial Choice Task **(C)**. Each T-maze have a central corridor as starting point, and two lateral choice arms at the end of which there was a food magazine. To gain access to the lateral arms, rats have to poke in a nose-port thereby triggering the opening of an automated door. Once in the lateral arm, rats can retrieve food (palatable pellets) and through a small runway go back to the start point to initiate another trial. Rats are first trained individually to poke in the nose port, retrieve food in the choice arm and go around the maze back to the starting point. Once training is complete the two T-mazes are placed facing each other **(C)** and the ability for rats to cooperate is tested. Importantly, the wall that separates the two mazes is transparent and perforated **(B)**, allowing rats to see, hear, smell and touch each other.

PROJECT

FELLOWSHIPS - BIAL FOUNDATION

COLLABORATORS

ALFONSO RENART
(Champalimaud Neuroscience Programme, Portugal)

Neural mechanisms of trace auditory fear conditioning

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. Progress in 2013: We are recording the activity of populations of simultaneously recorded neurons in medial prefrontal cortex during tAFC. Preliminary results show that single cell responses are quite diverse, with some neurons being inhibited, others excited or not responding to the tone. Hence investigating how the dynamics of neural activity at the population level may carry information about the occurrence of events in this task.

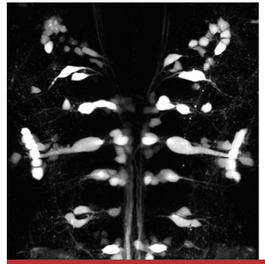
MICHAEL ORGER

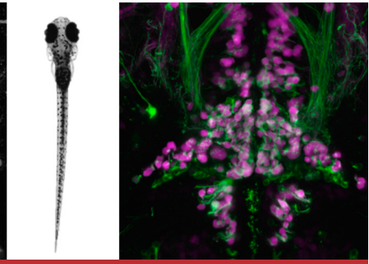
Principal Investigator

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 visualize 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





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PROJECT

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 swim 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

GRANTS - MARIE CURIE CAREER INTEGRATION GRANT;
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)

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.

COLLABORATORS

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(Department of Molecular and Cellular Biology, Harvard University, USA)

PROJECT

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, and 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.

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

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:

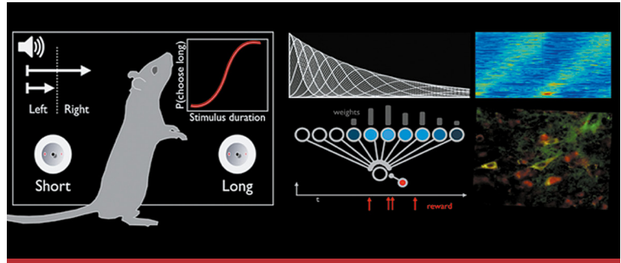
1. Optogenetically activate or silence these populations;
2. Record activity specifically from these populations;
3. Trace their projections in the brain.

LEARNING

JOE PATON
Principal Investigator

Learning to adaptively respond to cues in the environment that predict behaviourally relevant events is critical for survival. However animals are exposed to myriad 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



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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. Progress in 2013: We have finalized design of the electronics and are currently testing the hardware and developing software for use in all of our experimental paradigms. To this approach, we have added and invested heavily in big speedvideo 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 submitted at the end of 2013.

PROJECT

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 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 the SFI task mentioned above. 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. Progress in 2013: 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. We are currently attempting to inhibit DA neuron activity optogenetically to test the hypothesis that his manipulation will result in the speeding of internal timing mechanisms. In additon, we are performing more anatomically limited perturbations of the DAergic system to identify where in the brain our manipulations are having their effects.

PROJECT

GRANTS - BIAL FOUNDATION;
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A 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 frame work 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. Progress in 2013: 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

FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A 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. Progress in 2013: We are testing hypotheses about how time is encoded in neural populations that 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

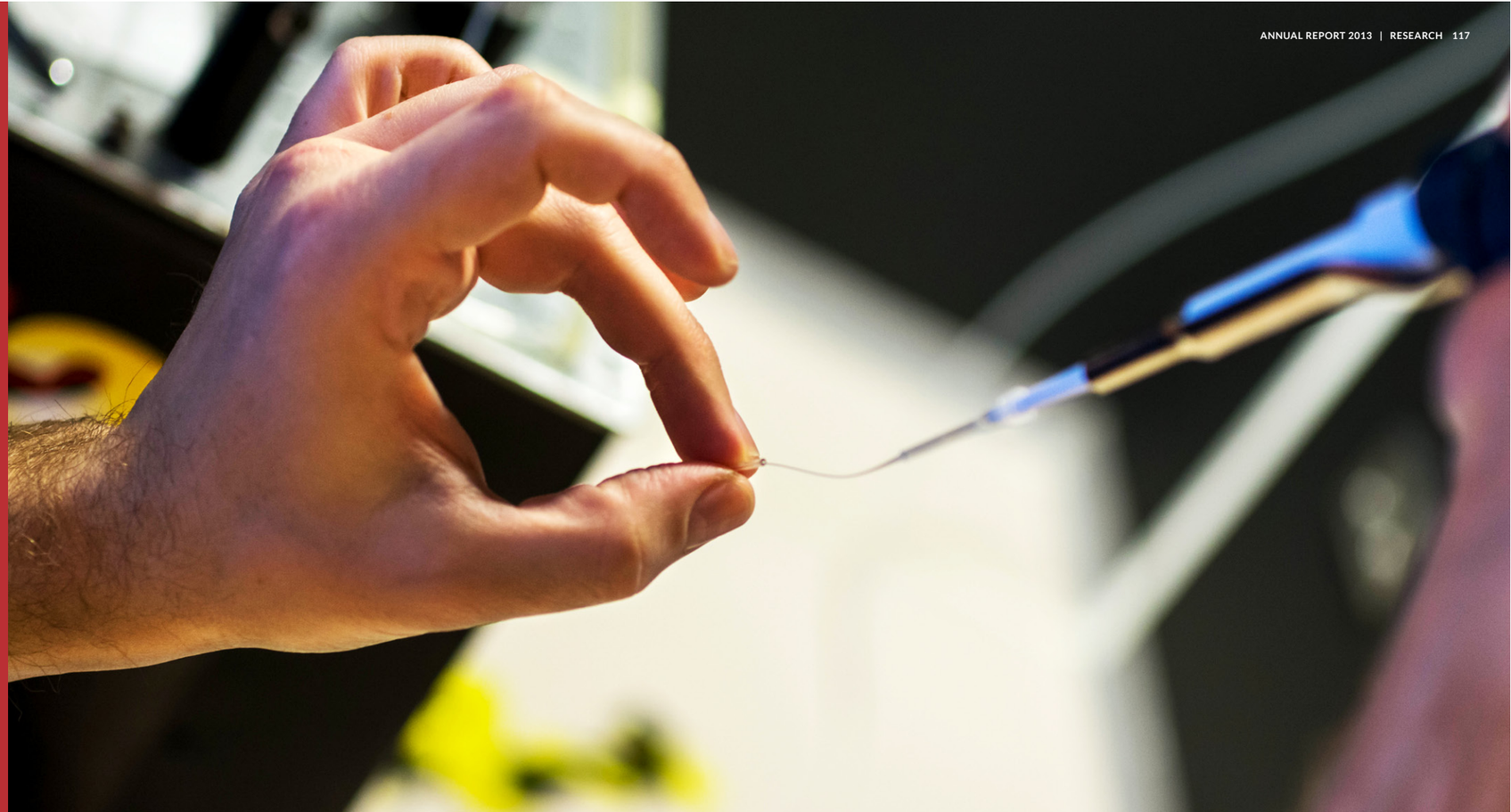
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)

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. Progress in 2013: 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)

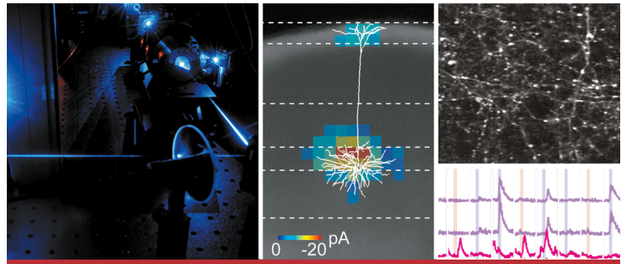


CORTICAL CIRCUITS

LEOPOLDO PETREANU
Principal Investigator

The neocortex plays a key role in sensory perception and higher cognitive functions. Unraveling how this seemingly simple sheet of neurons allows so many complex behaviors 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 neighboring 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



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* equal contribution

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PROJECT

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

GRANTS – HUMAN FROENTIERS 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 is 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 will 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

GRANTS - HUMAN FROENTIERS SCIENCE PROGRAMME (HFSP)

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 specialized 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

GRANTS – FP7 COOPERATION. (NEUROSEEKER)

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 2P Ca2+ imaging of neuronal population activity in the vicinity of the electrode.

ADDITIONAL COLLABORATORS

LIN TIAN
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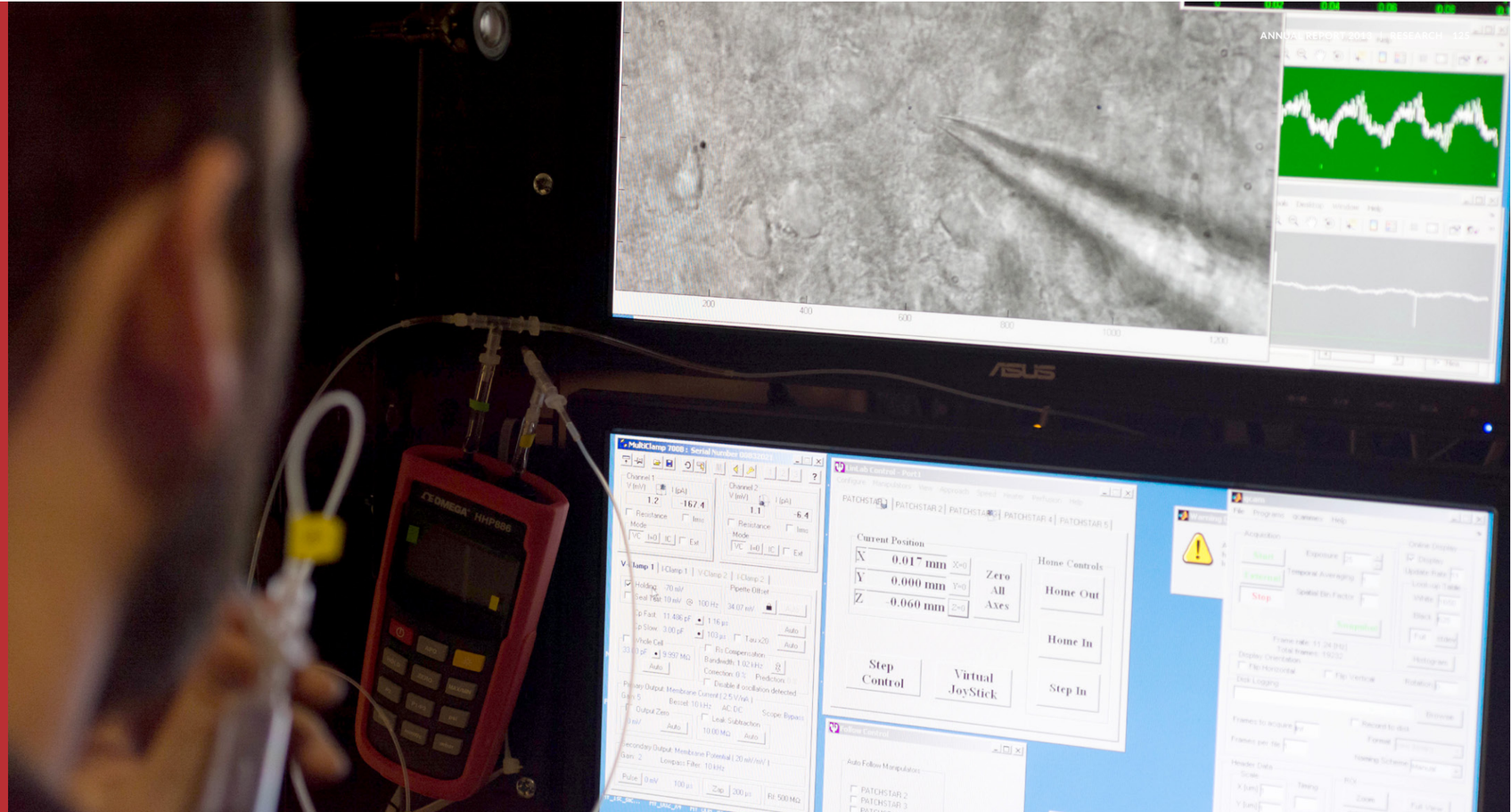
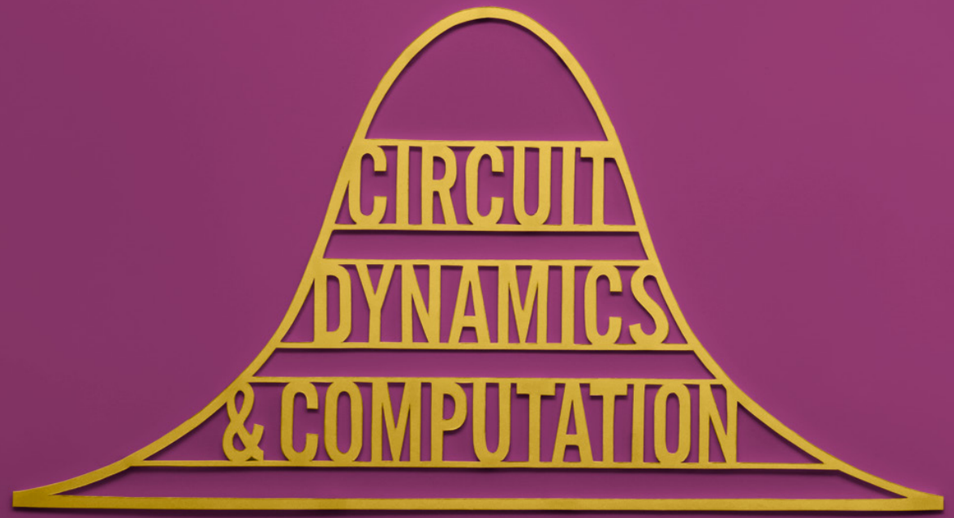
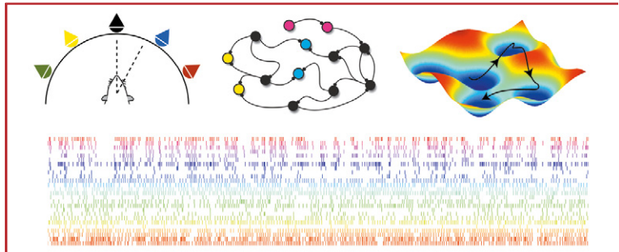




ALFONSO RENART
Principal Investigator

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 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



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* equal contribution

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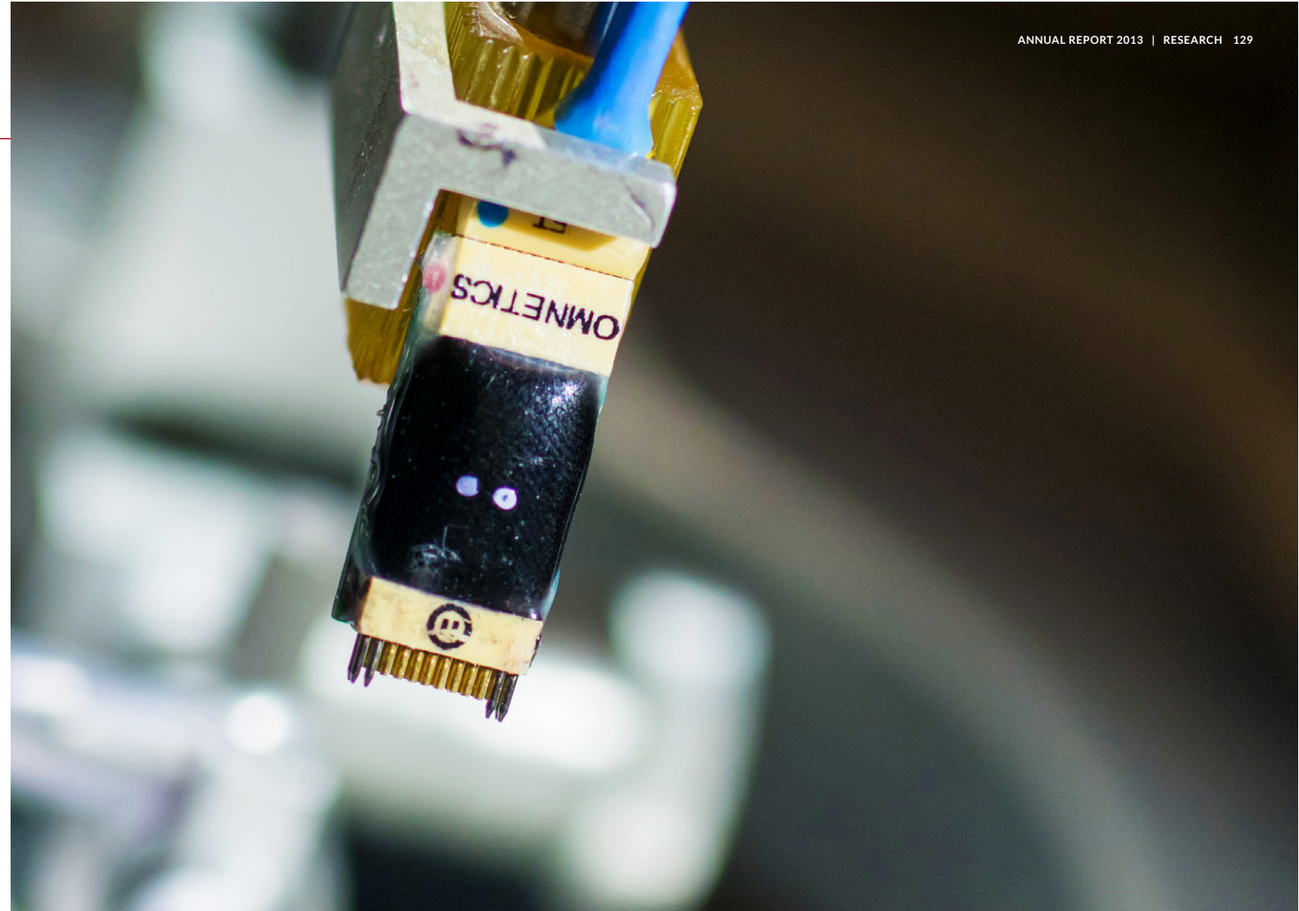


Population dynamics in the Auditory Cortex

PROJECT

GRANTS - FP7-PEOPLE (MARIE CURIE); FP7-COOPERATION (NEUROSEEKER); FELLOWSHIPS – HUMAN FROENTIERS SCIENCE PROGRAMME (HFSP)

COLLABORATORS

JAIME DE LA ROCHA AND ALBERT COMPTE (IDIBAPS, Spain)

Although anatomy makes it certain that information processing in the brain is the result of the interaction of neurons organised in networks spanning multiple spatial scales, our knowledge about the patterns of population activity associated to specific computations and about the mechanisms that generate these patterns in recurrent neuronal circuits is very incomplete. We are interested in the computations performed by local cortical circuits during perception. We use the auditory modality because rodents naturally use auditory cues to guide their behaviour and because it allows us to deliver complex stimuli in a well-controlled and repeatable fashion. We are developing auditory discrimination tasks built around a basic sound localization paradigm, which can easily and quickly be learnt by rodents. We record the simultaneous activity of multiple neurons from the auditory cortex both during performance of these tasks and during anesthesia in order to investigate questions such as the temporal evolution of sensory responses, the population structure of trial-to-trial variability and its relationship to behavioural accuracy, or the interplay between feed-forward and feed-back influences in perception.

The dynamical basis of working memory

PROJECT

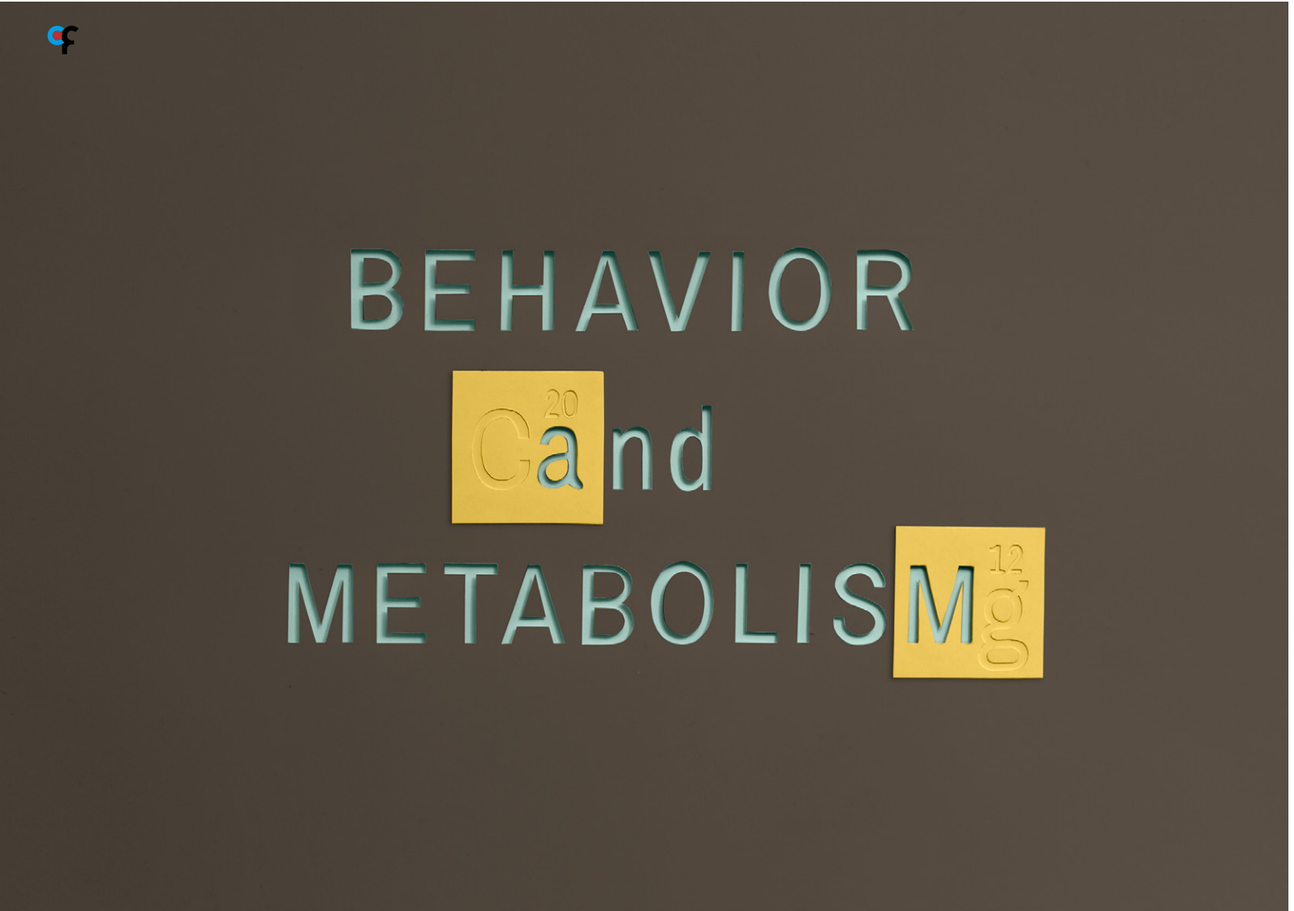
GRANTS - HUMAN FROENTIERS SCIENCE PROGRAMME (HFSP) YOUNG INVESTIGATOR AWARD

COLLABORATORS

PAUL CHADDERTON (Imperial College London, UK)
SEBASTIAN ROYER, (Center for Functional Connectomics, Seoul, Korea)

In order to guide behaviour, it is sometimes necessary to actively maintain or manipulate information which has been previously experienced, but is not 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.



CARLOS RIBEIRO
Principal Investigator

We are interested in understanding how molecular and cellular mechanisms control complex biological processes at the level of the whole organism. For this we are focusing on how the internal metabolic state of the fruit fly *Drosophila melanogaster* affects its behavioural decisions. Starting from novel behavioural paradigms we use molecular genetic techniques to identify and characterise genes and neuronal populations involved in producing the appropriate behavioural response to a specific metabolic need of the fly. We use tissue specific whole genome behavioural RNAi screens to identify molecular processes. Neuronal substrates are identified by screening for fly lines marking neuronal populations necessary to produce correct behavioural outputs. The identified molecular mechanisms and circuits are then analysed using quantitative behavioural observations, state of the art genetic and molecular techniques, as well as imaging approaches.

KEY PUBLICATIONS

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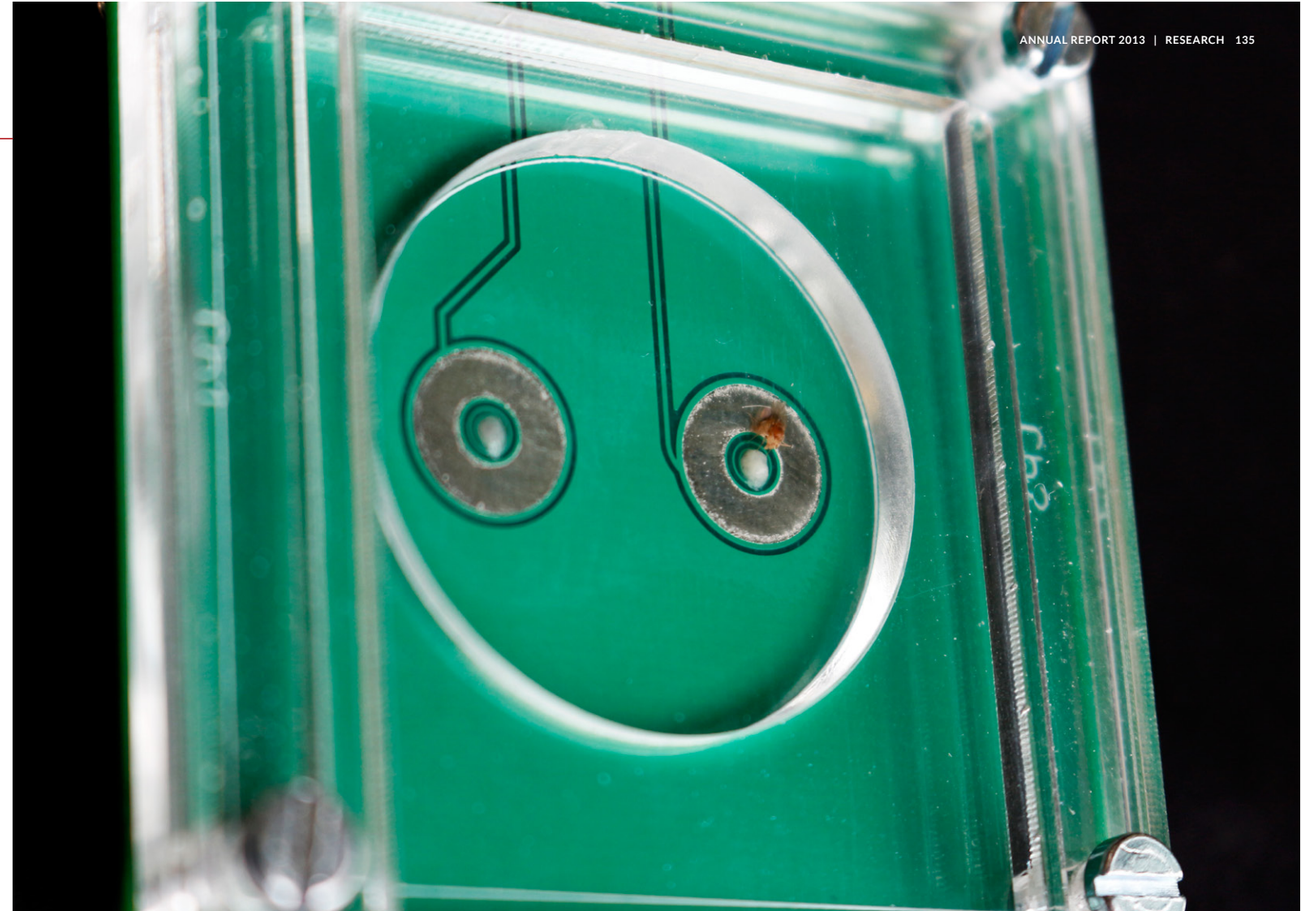


PROJECT

GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT), BIAL FOUNDATION;
FELLOWSHIPS - EMBO, CNPQ - NATIONAL COUNSEL OF TECHNOLOGICAL AND SCIENTIFIC DEVELOPMENT - BRASIL - PROGRAMA CIÊNCIA SEM FRONTEIRAS;
CHAMPALIMAUD FOUNDATION

COLLABORATORS

DR. MATTHEW PIPER AND PROF. LINDA PARTRIDGE (Institute of Healthy Ageing, University College London, UK)

What are the exact nutritional variables affecting nutritional decisions?

Animals choose which macronutrient to eat according to their current internal state and optimise the protein to carbohydrate ratio in their diet to maximiselife history traits. In the field it is well accepted that yeast is mainly used by *Drosophila* as a protein and therefore amino acid source but a detailed nutritional analysis of this food source remains hampered by its chemically complexity. Together with the laboratories of Dr. Matthew Piper and Prof. Linda Partridge at UCL we have used a novel holidic medium that is adequate for adult traits, such as behaviour, fecundity and lifespan. Using detailed and quantitative behaviour analyses of food choice and feeding behaviour we show that specifically removing amino acids from the diet leads to a foraging phenotype which fully mimics a lack of dietary yeast. 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

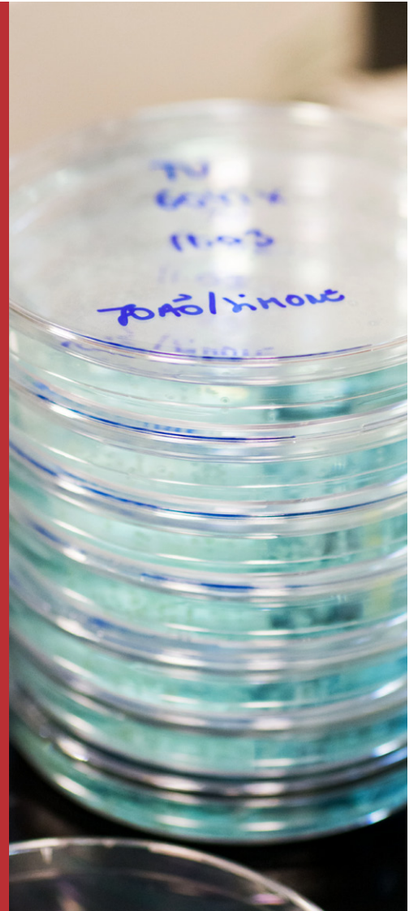
GRANTS - HUMAN FRONTIERS SCIENCE PROGRAMME (HFSP);
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT);
CHAMPALIMAUD FOUNDATION

COLLABORATORS

DR. ALDO FAISAL (Imperial College London, UK)
PROF. MICHAEL DICKINSON (University of Washington, USA)

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. With our collaborators we have developed flyPAD - fly Proboscis and Activity Detector, a method to automatically monitor feeding behaviour in individual flies. Our method is based on capacitive measurement of a fly's interaction with the food. The precision of the measurements opens the possibilities for high fidelity, high temporal resolution, unbiased measurements of feeding behaviour. This method complements continuing experimental and quantitative modeling approaches to understand how the internal state affects foraging and feeding strategies to achieve nutrient homeostasis.

PROJECT

GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT), BIAL FOUNDATION;
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT), EMBO, CNPQ - NATIONAL COUNSEL OF TECHNOLOGICAL AND SCIENTIFIC DEVELOPMENT - BRASIL - PROGRAMA CIÊNCIA SEM FRONTEIRAS;
CHAMPALIMAUD FOUNDATION

What are the molecular and cellular mechanisms used by the brain to identify what type of nutrients the animal needs and to change its behaviour to allow it to find and eat food containing the required nutrients?

At the centre of developing and deploying optimal strategies for nutrient uptake and utilization lies the ability of the central nervous system to detect the 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 choice in neuronal whole-genome RNAi screens we are investigating novel molecular mechanisms mediating nutrient

homeostasis. Taken together these studies are providing us with an entry point for studying nutrient balancing and value-based decision making at the molecular level, an entry point for studying nutrient balancing and value-based decision making at the molecular level.

PROJECT

GRANTS - HUMAN FRONTIERS SCIENCE PROGRAM, FP7-PEOPLE (MARIE CURIE ITN), FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT); FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT) ; CHAMPALIMAUD FOUNDATION

Which are the neuronal networks involved in nutrient homeostasis and what are the changes happening in them when the internal metabolic and mating state of the animal changes?

Currently only the neuronal population described by us to mediate the mating status of the fly is known to modulate nutrient homeostasis. To understand nutritional decision making it is essential that we identify and characterise further neuronal components controlling this important homeostatic behaviour. We are using genetic approaches to identify neuronal populations which are required for the fly to decide which nutrients to eat. Currently we are analysing identified neuronal substrates to understand how these neuronal populations act to guide feeding decisions. Being able to identify restricted sets of neurons is giving us the unique opportunity to make in depth analyses of the function of these neurons using activity imaging and electrophysiology as well as to characterise the molecular and cellular mechanisms acting in these neurons to mediate nutrient decisions.

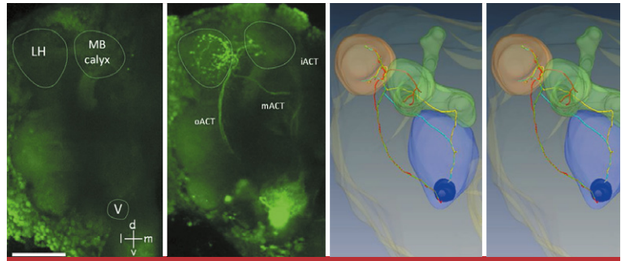
MARIA LUÍSA VASCONCELOS
Principal Investigator

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



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Sophie Dias
Research Technician

PROJECT

GRANTS – FP7-PEOPLE (MARIE CURIE IRG), 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. Progress in 2013: We have continued an intersectional approach to pinpoint which of the apterous neurons are important for female receptivity. We found that removing inhibition with 4 different promoters, rescues the phenotype. We finished an inactivation screen of one thousand janelia farm lines for female receptivity. An initial fertility screen identified 75 candidates. These where tested for receptivity and we confirmed 17 lines that show a reduction in receptivity.

PROJECT

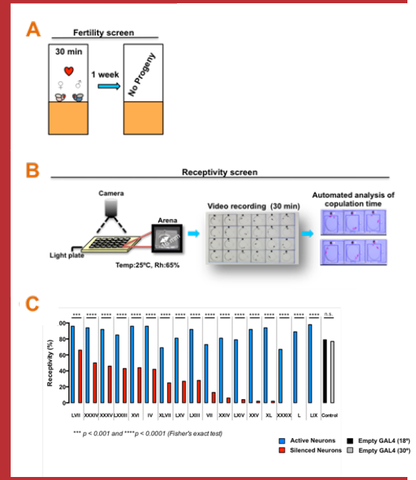
GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT); FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT).

COLLABORATORS

ILONA KADOW
(Max-Planck Institute of Neurobiology, Germany)

Across species stress odour response

Stressed Drosophila melanogaster release an aversive odourant that elicits a robust avoidance response in test flies. The active component of the stress odour is carbon dioxide. The robust response to a single stimulus provides a powerful framework for circuit mapping. We aim to characterise the circuit of carbon dioxide response. Progress in 2013: We begun a screen that combines imaging and behaviour to characterise the third order neurons of carbon dioxide response in the lateral horn. We use lines that label the lateral horn neuron and image their calcium responses upon activation of the V-glomerulus and we test their behavioural response to carbon dioxide when the neurons are inhibited.



IDENTIFICATION OF NEURONS CONTROLLING FEMALE SEXUAL BEHAVIOUR.
a. We used 1050 lines from the Janelia GAL4-Driver line collection to silence subsets of neurons by expressing an inwardly rectifying potassium channel. The lines were initially screened for fertility; **b.** 75 lines exhibited reduced fertility and they were subsequently evaluated for receptivity by video-recording the behaviour of mating pairs in a small chamber; **c.** Using this strategy, we were able to identify 17 lines with a significant decrease in female receptivity after neuronal silencing.

PROJECT

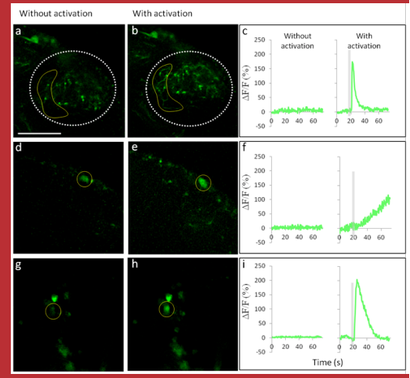
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)

COLLABORATORS

MARTA MOITA
(Champalimaud Neuroscience programme, Portugal)

Mechanism of propagation of defence responses in *Drosophila melanogaster*

To address the question of the neural mechanisms 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. Progress in 2013: We have started by establishing a paradigm to study a well known defence behaviour in flies, the escape flight/jump triggered by looming stimuli. We have found that flies will reliably jump to the first few presentations of a looming stimuli but revert to sustained freezing behaviour when more looming stimuli are presented.



STIMULATION OF THE V GLOMERULUS WITH ACETYLCHOLINE LEADS TO ACTIVATION OF THE LATERAL HORN (LH) AND CELL BODIES (CBS) AROUND THE LH. ACTIVATION IS MEASURED BY A FLUORESCENT CALCIUM INDICATOR.
a, **d** and **g**: Maximum projection images of the LH (white dashed circle) and two different CBs (yellow circles) without the acetylcholine stimulation. Each image corresponds to one brain; **b**, **e** and **h**: Maximum projection images of the LH (white dashed circle) and two different CBs (yellow circles) with the acetylcholine stimulation. Each image corresponds to one brain; **c**, **f** and **i**: Time course of fluorescence intensity change plotted for the areas marked in yellow without and with the acetylcholine stimulation. The gray bar indicates stimulus delivery. Scale bar = 50 µm. stimulation. Each image corresponds to one brain; **c**, **f** and **i**: Time course of fluorescence intensity change plotted for the areas marked in yellow without and with the acetylcholine stimulation. The gray bar indicates stimulus delivery. Scale bar = 50 µm.Using this strategy, we were able to identify 17 lines with a significant decrease in female receptivity after neuronal silencing.

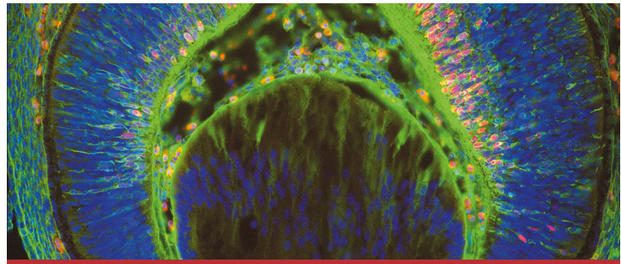
NEURAL DEVELOPMENT

ASSOCIATED LAB

DOMINGOS HENRIQUE
Principal Investigator

Our work focused on how cell fate decisions are controlled at the single-cell level, revealing how cell-cell communication functions to coordinate the proper assembly of tissues and organs. In the developing nervous system, our research allowed us to unravel how neuronal differentiation is controlled by the timing of Notch activity. We have also investigated how the pluripotent state is regulated in embryonic stem (ES) cells. 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. This research shall contribute to design more rational strategies to direct the in vitro and in vivo production of specific cell types, required to develop cell-replacement therapies in humans, aimed at regenerating damaged tissues and organs.

KEY PUBLICATIONS



Abranches, E., Silva, M., Pradier, L., Schulz, H., Hummel, O., Henrique, D., Bekman, E. (2009) *Neural Differentiation of Embryonic Stem Cells in vitro: a Road Map to Neurogenesis in the Embryo.* **PLos ONE 4(7):e6286.**

Henrique D, Bally-Cuif L (2010) *A cross disciplinary approach to understanding neural stem cells in development and disease.* **Development 137:1933-8.**

Vilas-Boas, F., Fior, R., Swedlow, J.D., Storey, K.G., Henrique, D. (2011) *A novel Reporter of Notch Signalling indicates regulated and random Notch Activation during Vertebrate Neurogenesis.* **BMC Biology 9:58.**

Fior, R., Henrique, D. (2005) *A novel hes5/hes6 circuitry of negative regulation controls Notch activity during neurogenesis.* **Dev. Biology 281:318-333.**

Abranches, E., Bekman, E., Henrique, D., Cabral, J. (2007) *Expansion of mouse embryonic stem cells on microcarriers.* **Biotechnol Bioeng 96:1211-21.**

LAB MEMBERS

Elsa Abranches, PhD
Postdoctoral Researcher

Anna Pezzarossa, PhD
Postdoctoral Researcher

Luis Guardado Suarez, PhD
Postdoctoral Researcher

Cláudia Gaspar, PhD
Postdoctoral Researcher

Alexandra Rosa, PhD
Postdoctoral Researcher

Sanja Ivkovic, PhD
Postdoctoral Researcher

Aida Costa
PhD Student

Ana M. Guedes
MIT-Portugal PhD Student

Sofia Duarte, MD
PFMA PhD Student

Pedro Barbacena
FCUL-BED Masters Student

Williane Alves
FCUL-BED Masters Student

Sara Ferreira
Research Technician

Catarina Ramos, PhD
PhD Postdoctoral Researcher,
FCT Fellow

PROJECT

GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT); FELLOWSHIPS – FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT); CHAMPALIMAUD FOUNDATION

The dialetics of "Stemness": from biology to mathematics

Our aim is to investigate the mechanisms underlying lineage specification in the pluripotent state, using ESCs as a model. Our work is directed at understanding i) how Nanog fluctuating expression in ESCs is regulated and ii) how Nanog modulates the competence of pluripotent cells for lineage specification. Our ongoing work led us to the hypothesis that the stochastic dynamics of a single regulatory molecule - Nanog itself -, endowed with a simple positive feedback mechanism acting at the post-transcriptional level, is sufficient to explain the dynamic heterogeneity of Nanog expression in ESCs. This work shall address our hypothesis that Nanog operates as an autonomous, self-regulated component of the pluripotency gene regulatory network, functioning as a noise modulator device to control cellular decision-making in pluripotent cells.

PROJECT

GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT); FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT); CHAMPALIMAUD FOUNDATION

The V2 domain of the spinal cord as a model to study neuronal fate decisions

In this project, our aim is to unravel how neuronal diversity is regulated in the V2 domain of the developing spinal cord, where V2a and V2b interneurons are generated at the same time from neuroepithelial progenitors. A unique regulatory circuitry is required to control neuronal diversification in this domain and our work supports a model where the sequential activity of two ligands, Dll1 and Dll4, coordinate consecutive steps in neurogenesis, controlling the rate of neuronal differentiation and creating diversity in the population of differentiating neurons. Our studies aim to contribute to the characterisation of the molecular pathways underlying the generation of neuronal diversity, and to elucidate how the combinatorial activities of bHLH proneural factors and Notch ligands can act in a coordinated manner. We are also investigating the transcriptional mechanisms that have evolved to direct the precise temporal and spatial expression of Dll4 in the V2 domain. Elucidating how the interplay between extrinsic cues (Notch signaling) and intrinsic factors (bHLH family members) determines the acquisition of unique neuronal differentiation programs will be essential to understand how neuronal circuits assemble in the nervous system and how they govern specific behaviours in the adult.

ADDITIONAL COLLABORATORS

ARJUN RAJ
Penn University, USA. (The dialetics of "Stemness": from biology to mathematics)
ANA POMBO
The Berlin Institute for Medical Systems Biology, Berlin, Germany (The dialetics of "Stemness": from biology to mathematics)

SOCIAL NEUROENDO-CRINOLOGY

ASSOCIATED LAB

RUI OLIVEIRA
Principal Investigator

The main research interest of the lab is the integrative study of social behaviour that combines the study of proximate causes (gene modules, hormones, neural circuits, cognitive processes) and ultimate effects (evolutionary consequences). We have mainly focused on the plasticity in social behaviour at two different levels of variation: (1) behavioural flexibility – transient and reversible changes in social behaviour driven by social experience or social context; and (2) developmental plasticity – irreversible switches between discrete behavioural phenotypes expressed by the same genotype, driven by developmental processes in response to environmental cues. We expect to show how knowledge of the proximate mechanisms underlying social plasticity is crucial to understanding its costs, limits and evolutionary consequences. We use both zebrafish and non-model fish species that exhibit social plasticity and can be studied in ecologically relevant settings.

KEY PUBLICATIONS

Taborsky B, Oliveria RF (2012) *Social competence: an evolutionary approach.* **Trends in Ecology and Evolution 27: 679-688.**

Soares MC, Oliveria RF, Ros AFH, Grutter AS, Bshary R (2011) *Tactile stimulation lowers stress in fish.* **Nature Communications 2: 534.**

Antunes RA, Oliveria RF (2009) *Hormonal anticipation of territorial challenges in cichlid fish.* **Proceedings of the National Academy of Sciences U.S.A. 106: 15985-15989.**

Oliveria RF, Carneiro LA, Canário AVM (2005) *No hormonal response in tied fights.* **Nature 437: 207-208.**

Oliveria RF, Lopes M, Carneiro LA, Canário AVM (2001) *Watching fights raises fish hormone levels.* **Nature 409: 475.**

LAB MEMBERS

João Machado Lopes, PhD
Postdoctoral Researcher

Sónia Cobra Cardoso
University of Algarve
PhD Student, FCT Fellow

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University of Algarve
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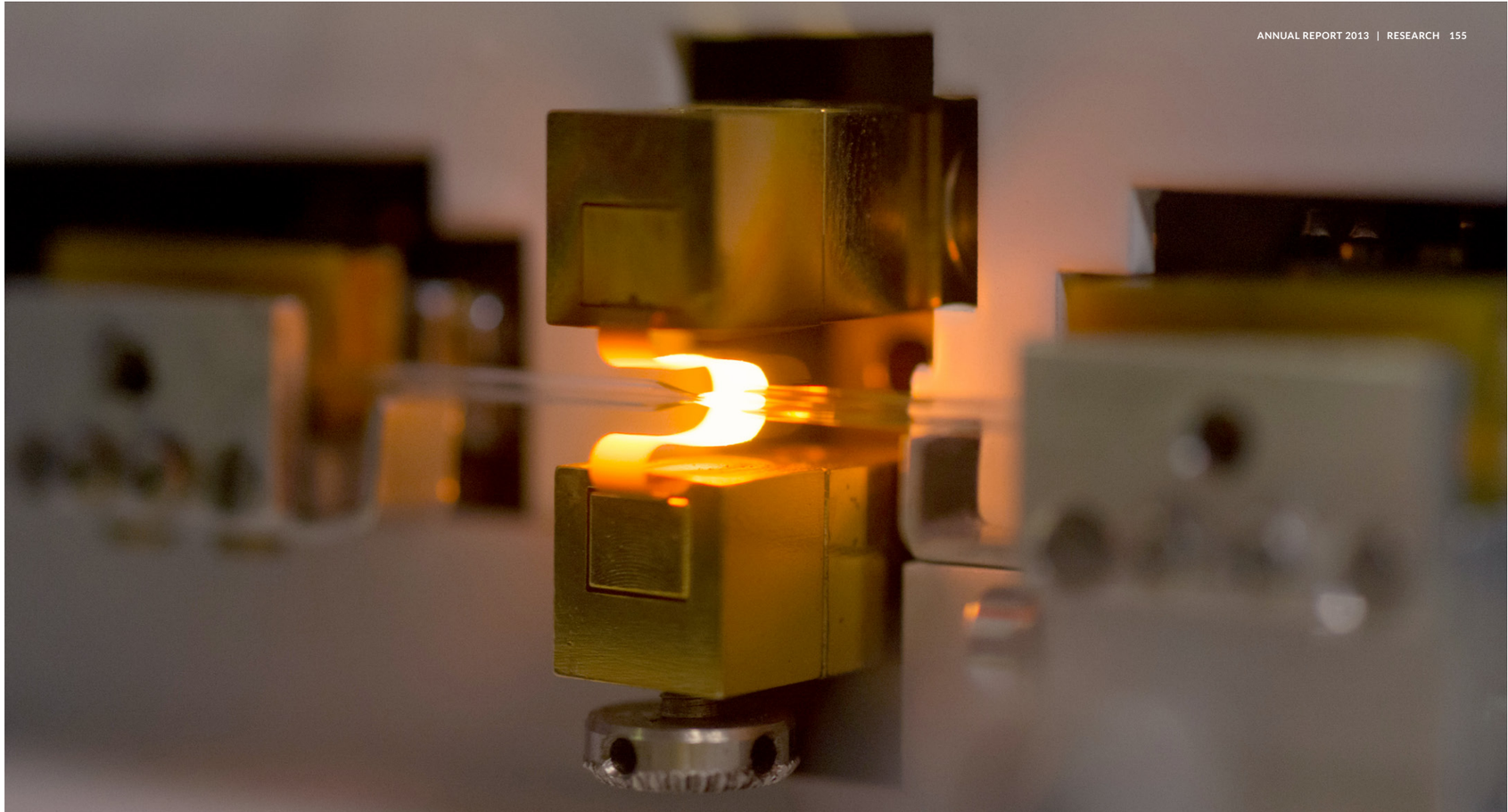
FCT Fellow

José Miguel Simões
FCUL PhD Student,
FCT Fellow

André Almeida Tacão
FCUL Masters Student

Julia Ferreira Pinho
Research Technician

António Roleira
Fish Facility Technician



PROJECT

GRANTS – FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT);
FELLOWSHIPS – FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)

COLLABORATORS

GIL LEVKOWITZ (Weizmann Institute, Israel)
HANS HOFMANN (University of Texas Austin, USA)
JORG BECKER (IGC, Portugal)
DANIEL PETERSEN (The Chicago Medical School at Rosalind Franklin University of Medicine and Science, North Chicago, Illinois, USA)

Molecular mechanisms and evolutionary implications of social plasticity

Here we propose an integrative framework for understanding the proximate mechanisms and ultimate consequences of social plasticity. As a result of this project we expect to show how knowledge of the proximate mechanisms underlying social plasticity is crucial to understanding its costs, limits and evolutionary consequences, therefore highlighting the fact that proximate mechanisms of nonheritable phenotypic variation contribute to the dynamics of selection. The following questions will be addressed:

1. What are the mechanisms animals use for sensing and responding adaptively to environmental cues that trigger plastic responses?
2. How can the same genome produce different social phenotypes in response to cues provided by the social environment?
3. Is plasticity itself subject to selection and might therefore evolve?

Different fish species were choosen as study models to address each question due to the fact that teleosts are the most diverse and plastic taxa among vertebrates.

PROJECT

GRANTS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT);
FELLOWSHIPS - FUNDAÇÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT);
CHAMPALIMAUD FOUNDATION.

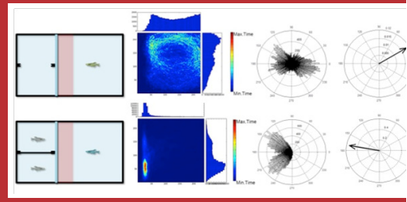
COLLABORATORS

KOICHI KAWAKAMI (National Institute of Genetics, Japan)

Comparative social cognition: zebrafish as a neurobehavioural model

Main goals:

1. To establish the occurrence of cognitive appraisal in zebrafish and identify the brain areas involved in the evaluation of valence and salience of social stimuli;
2. To assess the occurrence of social learning in zebrafish and characterise the underlying neural mechanisms;
3. To genetically dissect (using GAL4-UAS enhancer trap lines available with restricted expression in different brain areas) the neural circuits involved in social cognition (identified in previous points) to manipulate cognitive appraisal and social learning mechanisms.



ZEBRAFISH IS USED IN OUR LAB AS A MODEL TO STUDY SOCIAL BEHAVIOUR AND COGNITION.
A behavioural paradigm to study social preference in zebrafish is shown, where the position and head-tail orientation of the focal fish are used as a measure of preference: (top panel) exposure to empty tanks elicits no position or orientation bias; (bottom panel) exposure to two conspecifics induces a bias in orientation (towards conspecifics) and position (closer to the preferred target fish).

A new integrative framework for the study of fish welfare based on the concepts of allostasis, appraisal and coping styles

Objectives:

4. To test the occurrence of cognitive appraisal in fish and to understand how fish experience appetitive and aversive stimuli by assessing the behavioural, neurophysiological and genomic profiles of fish exposed to stimuli with positive or negative valence;
5. To provide tools and methods to measure appraisal in fish;

6. To investigate how appraisal differs between species and individuals with different coping styles;
7. To explore how predictability and controllability modulate appraisal and coping ability in fish.

Neural mechanisms of cognitive bias

In this project we aim to uncover the genetic pathways and neural circuits involved in cognitive appraisal and in the response to stressors, using zebrafish as a model organism. The broader goals of the project are:

1. To develop a behavioural assay to test cognitive bias in zebrafish and to characterise the neural circuits involved in stimulus appraisal;
2. To assess if cognitive bias (e.g. *pessimistic bias*) is mediating the inter-individual variation in the susceptibility to the detrimental effects of stress (using behavioural, systemic, and cellular read-outs);
3. To manipulate genetically (using GAL4-UAS enhancer trap lines) the neural circuits involved in the cognitive appraisal of stressors and check its effects on the activation of the stress response. Although this project is focused on basic biological mechanisms of stress, its outcomes have the potential to open the way for the use of zebrafish as a stress model organism in translational biomedical research.

PROJECT

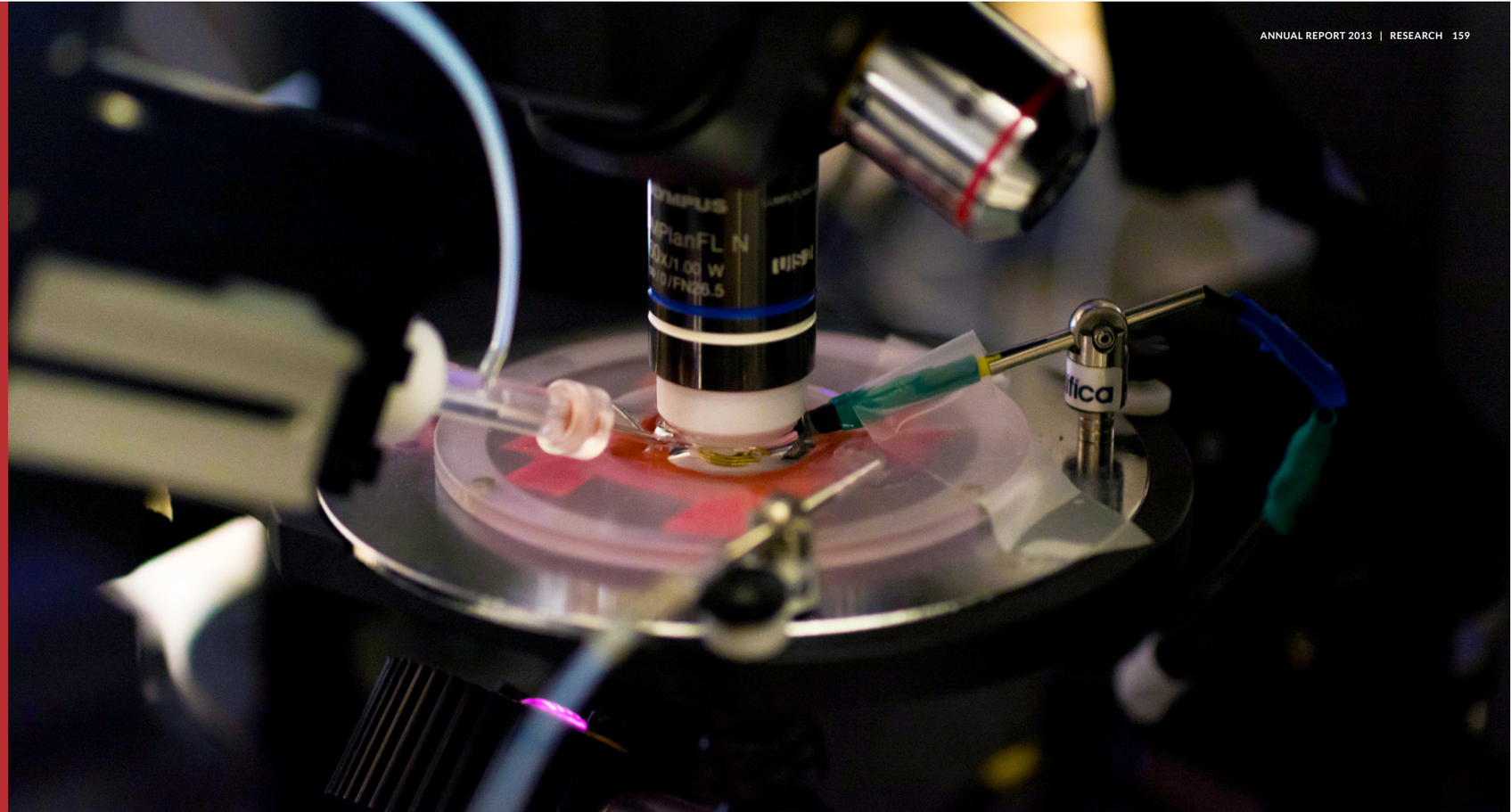
GRANTS - FUNDAÇÃO BIAL

COLLABORATORS

MIGUEL GODINHO FERREIRA
(IGC, Portugal)

ADDITIONAL COLLABORATORS

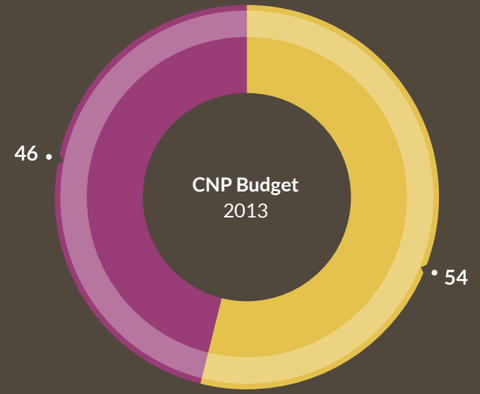
ELIANE GONÇALVES-DE-FREITAS
UNESP, Brazil. (Social stress and cognitive bias in Tilapia)
MICHAEL ORGER
Champalimaud Neuroscience Programme, Lisbon, Portugal. (Searching for the social brain in a model organism: unveiling the neural circuitry underlying social cognition in zebrafish).



TO FACILITATE THE QUEST OF SCIENTISTS

TO UNDERSTAND HOW NEURAL CIRCUITS GENERATE BEHAVIOUR

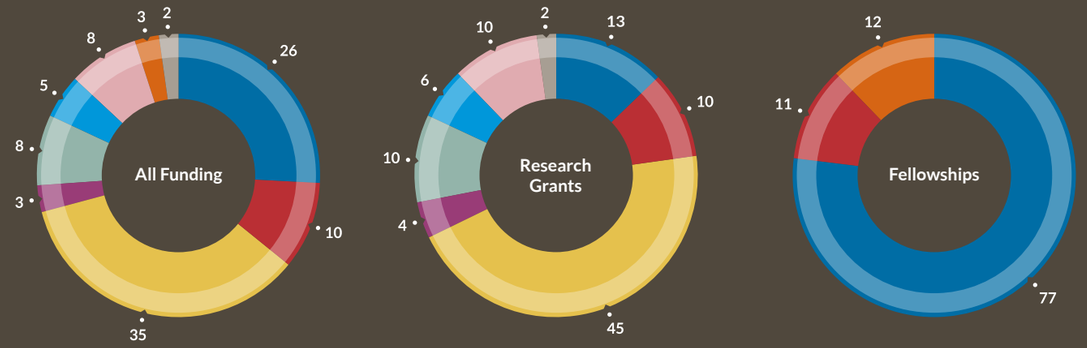
AS OF DECEMBER 2013, **103** ACTIVE RESEARCH GRANTS AND FELLOWSHIPS WERE RUNNING AT THE CNP.
THESE FUNDS WERE AWARDED BY THE FOLLOWING AGENCIES AND ORGANISATIONS:



Results presented in %

- Internal Funding
- External Funding

THESE EXTERNAL FUNDS WERE AWARDED BY THE FOLLOWING AGENCIES AND ORGANISATIONS:



Results presented in %

- Fundação para a Ciência e a Tecnologia
- International Human Frontier Science Program
- FP7-Ideas (European Research Council)
- Fundação Bial
- FP7-People (Marie Curie)
- FP7-Cooperation
- Howard Hughes Medical Institute
- Other (Austrian Academy of Science, Wellcome Trust, European Molecular Biology Organisation, Helen Hay Whiney Foundation)
- Human Brain Project

- RESEARCH GRANTS -

HOWARD HUGHES MEDICAL INSTITUTE
International

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

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

FP7-COOPERATION
European Union

BrainFlight
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

Copewell
A new integrative framework for the study of fish welfare based on the concepts of allostasis, appraisal and coping styles
2011-2015
AWARDED TO AN INTERNATIONAL GROUP OF INVESTIGATORS, INCLUDING RUI OLIVEIRA

FP7
European Union

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-IDEAS (EUROPEAN RESEARCH COUNCIL)
European Union

ERC Starting Grant, European Research Council
Circuits of con-specific 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)
European Union

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

FUNDACÃO BIAL
Portugal

Bial Science Research Grant
Bridging between events and their consequences: the role of prefrontal cortex
2013-2015
AWARDED TO EKATERINA VINNIK

Bial Science Research Grant
Neural mechanisms of cognitive bias
2013-2016
AWARDED TO RUI OLIVEIRA

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
Neuronal mechanisms underlying sex hormone-dependent switching of sexual receptivity
2011-2013
AWARDED TO SUSANA LIMA

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)
Portugal

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
Molecular mechanisms and evolutionary implications of social plasticity
2013-2016
AWARDED TO RUI OIVEIRA

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
The V2 domain of the spinal cord as a model to study neuronal fate decisions
2012-2015
AWARDED TO DOMINGOS HENRIQUE

Research Project Grant
Dissecção das bases moleculares e dos circuitos envolvidos na intenção
2011-2014
AWARDED TO RUI COSTA

Research Project Grant
The dialetics of "Stemness": from biology to mathematics"
2010-2013
AWARDED TO DOMINGOS HENRIQUE

Research Project Grant
Unravelling the Neuronal Circuits Underlying Female Receptivity
2010-2013
AWARDED TO MARIA LUÍSA VASCONCELOS

Research Project Grant
From genes to behaviour: dissecting the basis for CO2 response across Drosophilids
2010-2013
AWARDED TO MARIA LUÍSA VASCONCELOS

Research Project Grant
Identifying and characterising the molecular mechanisms at the basis of nutritional decisions
2012-2015
AWARDED TO CARLOS RIBEIRO

INTERNATIONAL HUMAN FRONTIER SCIENCE PROGRAMME ORGANISATION (HFSPO)
International

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
Olfactory objects and decisions: From psychophysics to neural computation
2010-2013
AWARDED TO ZACHARY MAINEN, ALEX POUGET AND MATTHIEU LUIS

HFSP Program Grant
Value-based decision making in Drosophila foraging: genes, computations and behaviour
2012-2015
AWARDED TO CARLOS RIBEIRO

SIMONS FOUNDATION
INTERNATIONAL

Project Award
Dissecting Striatal Circuit dynamics during repetitive behaviours in ASD
2014-2015 (officially announced in 2013)
AWARDED TO RUI COSTA

- 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

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

FUNDACÃO PARA A CIÊNCIA E A TECNOLOGIA (FCT)
Portugal

Postdoctoral Fellowship
2010-2013
AWARDED TO HOPE JOHNSON

Postdoctoral Fellowship
2012-2015
AWARDED TO PAVEL ITSKOV

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 ZITA SANTOS

Postdoctoral Fellowship
2011-2013
AWARDED TO FATUEL TECUAPELTA

PhD Fellowship
2013-2016
AWARDED TO ASMA MOTIWALA

PhD Fellowship
2013-2016
AWARDED TO DANBEE KIM

PhD Fellowship
2013-2016
AWARDED TO HEDI YOUNG

PhD Fellowship
2013-2016
AWARDED TO MARINA FRIDMAN

PhD Fellowship
2013-2016
AWARDED TO MERT ERGINKAYA

PhD Fellowship
2013-2016
AWARDED TO MICHAEL PEREIRA

PhD Fellowship
2013-2016
AWARDED TO NUNO CALAIM

PhD Fellowship
2013-2016
AWARDED TO NUNO LOUREIRO

PhD Fellowship
2013-2016
AWARDED TO RAPHAEL STEINFELD

PhD Fellowship
2013-2017
AWARDED TO RITA FÉLIX

PhD Fellowship
2012-2015
AWARDED TO JOÃO AFONSO

PhD Fellowship
2012-2015
AWARDED TO SILVANA ARAÚJO

PhD Fellowship
2012-2015
AWARDED TO JOAQUIM JACOB

PhD Fellowship
2012-2015
AWARDED TO RICARDO SILVA ZACARIAS

PhD Fellowship
2012-2015
AWARDED TO JENS BIERFELD

PhD Fellowship
2012-2015
AWARDED TO JACQUES BOURG

PhD Fellowship
2012-2015
AWARDED TO ROBERTO MEDINA

PhD Fellowship
2013-2017
AWARDED TO DANA DARMOHRAY

PhD Fellowship
2012-2015
AWARDED TO SOFIA SOARES

PhD Fellowship
2012-2015
AWARDED TO LUÍS MOREIRA

PhD Fellowship
2011-2014
AWARDED TO GONÇALO LOPES

PhD Fellowship
2011-2014
AWARDED TO GUSTAVO MELLO

PhD Fellowship
2011-2014
AWARDED TO SIMONE LACKNER

PhD Fellowship
2011-2014
AWARDED TO TIAGO MARQUES

PhD Fellowship
2011-2014
AWARDED TO RAIMUNDO LEONG

PhD Fellowship
2011-2014
AWARDED TO PATRÍCIA RACHINAS-LOPES

PhD Fellowship
2010-2013
AWARDED TO NICCOLÒ BONACCHI

PhD Fellowship
2010-2013
AWARDED TO ANDREIA CRUZ

PhD Fellowship
2010-2013
AWARDED TO ELIZABETH RICKENBACHER

PhD Fellowship
2010-2013
AWARDED TO THIAGO GOUVÊA

PhD Fellowship
2010-2013
AWARDED TO ALI ARGUNSAH

PhD Fellowship
2010-2013
AWARDED TO ANNA HOBBISS

PhD Fellowship
2010-2013
AWARDED TO SEVINÇ MUTLU

PhD Fellowship
2010-2013
AWARDED TO SUSANA VALENTE

PhD Fellowship
2010-2013
AWARDED TO ANA MACHADO

PhD Fellowship
2010-2013
AWARDED TO VERÓNICA CORRALES

PhD Fellowship
2009-2013
AWARDED TO ANA RITA FONSECA

PhD Fellowship
2009-2013
AWARDED TO ANDRÉ MENDONÇA

PhD Fellowship
2009-2013
AWARDED TO ANA PEREIRA

PhD Fellowship
2009-2013
AWARDED TO SCOTT RENNIE

PhD Fellowship
2009-2013
AWARDED TO FERNANDO SANTOS

PhD Fellowship
2009-2013
AWARDED TO ANA MAFALDA VICENTE

PhD Fellowship
2009-2013
AWARDED TO DENNIS HERRMANN

PhD Fellowship
2009-2013
AWARDED TO JOÃO MARQUES

PhD Fellowship
2012-2016
AWARDED TO SAMANTHA HERBERT

PhD Fellowship
2012-2015
AWARDED TO CATARINA ALBERGARIA

INTERNATIONAL HUMAN FRONTIER SCIENCE PROGRAMME ORGANISATION (HFSPO) INTERNATIONAL

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

SWISS NATIONAL SCIENCE FOUNDATION

2012-2013
AWARDED TO SABINE RENNINGER

WELLCOME TRUST | UK

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

CIÊNCIA VIVA

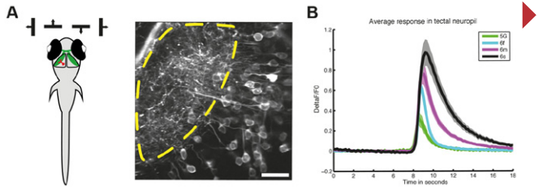
Escolher Ciência, Ciência Viva - National Agency for Scientific and Technologic Culture
2012-2014
AWARDED TO SCIENCECALIFRAGILISTIC TEAM

PUBLICATIONS

ADVANCING SCIENTIFIC KNOWLEDGE

WHILE ADVANCING THE SCIENTIFIC PROCESS ITSELF

PI HIGHLIGHTS



SPARKS OF INSIGHT

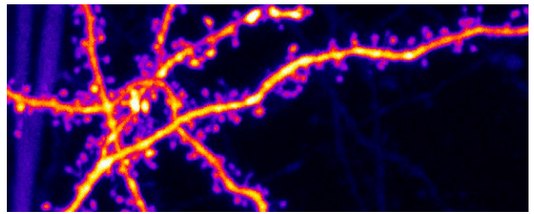
What if we could actually see what individual neurons do in real time inside a living brain? This study presents new genetically encoded 'GCaMP6' reporters that enable researchers to optically record the complex activity dynamics in neuronal populations.

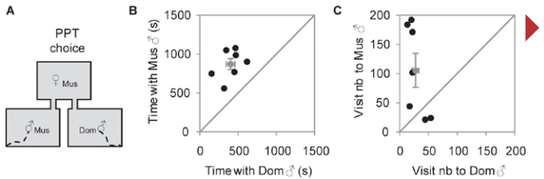
Chen TW, Wardill TJ, Sun Y, Pulver SR, Renninger SL, Baohan A, Schreiter ER, Kerr RA, **Orger MB**, Jayaraman V, Looger LL, Svoboda K, Kim DS (2013). Ultrasensitive fluorescent proteins for imaging neuronal activity. Nature 499(7458):295-300.

CAN FORGETTING TAKE ON A PHYSICAL FORM?

This study describes the physical changes that happen in our brains as our memories are changed or forgotten. The researchers discovered a somewhat counterintuitive result – both neural activity and protein synthesis are needed in order to make dendritic spines shrink or disappear.

Ramiro-Cortés Y, **Israely I** (2013). Long Lasting Protein Synthesis- and Activity-Dependent Spine Shrinkage and Elimination after Synaptic Depression. PLoS ONE 88 (8) :e71155





IS HE "THE ONE"? IT ALL DEPENDS ON YOUR OPTIONS...

Using a novel behavioural paradigm, this study explores the mating choices of mice, revealing that mating is influenced not only by species preference, but also by the internal state of the female and the nature of the encounter.

Zinck L, **Lima SQ** (2013). Mate Choice in Mus musculus Is Relative and Dependent on the Estrous State. PLoS ONE. 8(6): e66064.

INDP HIGHLIGHTS

HOPPING BETWEEN DR.JEKYLL AND MR.HYDE

In this study, the researchers discovered what cognitive changes happen when the locust transforms between two extreme forms – how does its ability to learn change and whether memories formed in one state can then be transferred to the other.

Simões PM, Niven JE, Ott SR (2013). Phenotypic transformation affects associative learning in the desert locust. Curr Biol. 23(23):2407-12.

ANTS WON'T SETTLE FOR LESS THAN THE BEST

We've all been there. The apartment is a bit too small; the heating doesn't work so well, but is it time to make a move? This study demonstrated that ants are constantly looking for a better place to live, unless their nest is just excellent.

Doran C, Pearce T, Connor A, Schlegel T, Franklin E, Sendova-Franks AB, Franks NR (2013) Economic investment by ant colonies in searches for better homes Biol. Lett. 9 (5): 20130685.

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Abranches E, Bekman E, Henrique D. (2013) *Generation and Characterization of a Novel Mouse Embryonic Stem Cell Line with a Dynamic Reporter of Nanog Expression.* PLoS ONE. 8(3): e59928.

Ahrens MB, Orger MB, Robson DN, Li JM, Keller PJ. (2013) *Whole-brain functional imaging at cellular resolution using light-sheet microscopy. Nat.* Methods. 10(5):413-20.

Akerboom J, Carreras Calderón N, Tian L, Wabnig S, Prigge M, Tolö J, Gordus A, Orger MB, Severi KE, Macklin JJ, Patel R, Pulver SR, Wardill TJ, Fischer E, Schüler C, Chen TW, Sarkisyan KS, Marvin JS, Bargmann CI, Kim DS, Kügler S, Lagnado L, Hegemann P, Gottschalk A, Schreiter ER, Looger LL. (2013) *Genetically encoded calcium indicators for multi-color neural activity imaging and combination with optogenetics.* Front. Mol. Neurosci. 6:2.

Audero E, Mlinar B, Baccini G, Skachokova ZK, Corradetti R, Gross C. (2013) *Suppression of Serotonin Neuron Firing Increases Aggression in Mice.* J. Neurosci. 33(20): 8678-88.

Bräcker LB, Siju KP, Varela N, Aso Y, Zhang M, Hein I, Vasconcelos ML, Grunwald Kadow IC. (2013) *Essential Role of the Mushroom Body in Context-Dependent CO2 Avoidance in Drosophila.* Curr. Biol. 23(13): 1228-34.

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

Cao VY, Ye Y, Mastwal SS, Lovinger DM, Costa RM, Wang KH. (2013). *In vivo two-photon imaging of experience-dependent molecular changes in cortical neurons.* J Vis Exp. 2013 Jan 5;(71). doi:pii: 50148. 10.3791/50148.

Chen TW, Wardill TJ, Sun Y, Pulver SR, Renninger SL, Baohan A, Schreiter ER, Kerr RA, Orger MB, Jayaraman V, Looger LL, Svoboda K, Kim DS. (2013) *Ultrasensitive fluorescent proteins for imaging neuronal activity.* Nature. 499(7458):295-300.

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(7436):238-42.

Doran C, Pearce T, Connor A, Schlegel T, Franklin E, Sendova-Franks AB, Franks NR. (2013) *Economic investment by ant colonies in searches for better homes.* Biol. Lett. 9(5): 20130685.

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Galhardo L, Oliveira RF. (2013) *The effects of social isolation on steroid hormone levels are modulated by previous social status and context in a cichlid fish.* Horm. Behav. 65(1):1-5.

Gremel CM, Costa RM. (2013) *Orbitofrontal and striatal circuits dynamically encode the shift between goal-directed and habitual actions.* Nat. Commun. 4: 2264.

Gremel CM, Costa RM (2013). *Premotor cortex is critical for goal-directed actions. Front. Comput.* Neurosci. 7:110. doi: 10.3389/fncom.2013.00110.

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Mendonça R, Soares MC, Bshary R, Oliveira RF (2013). *Arginine vasotocin neuronal phenotype and interspecific cooperative behaviour.* Brain Behaviour and Evolution 82:166-76.

Oliveira GA, Uceda-Gutierrez S, Oliveira T, Fernandez A, Garcia Marques T, Oliveira RF (2013). *Threat perception and familiarity moderate the androgen response to competition in women.* Frontiers in Psychology 4: e389.

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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.

Renninger SL, Orger MB (2013). *Two-photon imaging of neural population activity in zebrafish.* Methods 15;62(3):255-67.

Sanchez-Ripoll Y, Bone HK, Owen T, Guedes AM, Abranches E, Kumpfmueller B, Spriggs RV, Henrique D, Welham MJ (2013). *Glycogen synthase kinase-3 inhibition enhances translation of pluripotency-associated transcription factors to contribute to maintenance of mouse embryonic stem cell self-renewal.* PLoS One 8(4):e60148.

Simões PM, Niven JE, Ott SR. (2013) *Phenotypic Transformation Affects Associative Learning in the Desert Locust.* Curr. Biol. 23(23):2407-12.

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Zinck L, Lima SQ. (2013) Mate Choice in Mus musculus Is Relative and Dependent on the Estrous State . PLoS ONE. 8(6): e66064.

CONFERENCE ARTICLES

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REVIEW ARTICLES

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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. The team strives 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.

ADMINISTRATIVE OFFICE

PHILIPP TSOLAKIS
Group Head, Financial Manager / Controller

ALEXANDRA PIEDADE
Human Resources, INDP Assistant

BRUNO CEÑA
Lab administrator

FRANCISCO SEMEDO
Lab Administrator

RAQUEL GONÇALVES
Purchasing and Ordering

SHIRA LOTTEM
Admin Data Architect

TÂNIA LI CHEN
Teaching Lab Manager

TERESA CARONA
Human Resources, INDP Assistant

The Administrative Office provides all the 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.

ASSISTANT TO THE DIRECTOR

INÊS SOEIRO
Assistant to
the Director

The position of Assistant to the Director provides senior-level executive support to the Scientific Director of the Champalimaud Neuroscience Programme (CNP) by providing administrative assistance to the daily activities of the Director's office and by managing the Director's agenda and scheduling.

SCIENCE COMMUNICATION OFFICE

CATARINA RAMOS
Group Head

LIAD HOLLENDER
Science Communication

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.

OUTREACH

TO SHARE OUR KNOWLEDGE

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

CATARINA RAMOS
Group Head

LIAD HOLLENDER
Science Communication

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.

Outreach and communication activities are coordinated by the Science Communication Office. 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.

MAIN PROJECTS

SCIENCECALIFRAGILISTIC

Instructors: Catarina Ramos, Elsa Abranches, Pedro Ferreira, Ana Pereira, Ana Mafalda Vicente, Andreia Cruz, Maria Inês Vicente, Rodrigo Abreu

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 is 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 are 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, analyse and discuss 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 first cycle started in January 2013 and has completed the project in June 2013 with a concluding symposium. Twelve students were selected to the project, based on their motivation letters: six 12th grade students from Escola Secundária de Miraflores and six 11th grade students from Escola Secundária D. Luisa de Gusmão. The second cycle began in January of 2014 and is expected to finish in June of the same year.

The project was also presented at TEDx Youth in Leiria, Portugal by Catarina Ramos and Maria Inês Vicente, with the support of all other members of the Sciencecalifragilistic team. The theme of the event was ‘Invert your thinking’, and the members of Sciencecalifragilistic demonstrated how their project aims to change and enrich the way individuals think about science and non-scientific topics.

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.

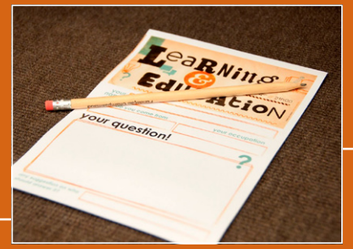
Ar events explore fundamental scientific themes by intertwining work from leading thinkers, both local and international. On each event scientists and non-scientist, such as plastic artists, chefs, mind readers, group facilitators, cyborgs and others, engage the public to think, interact and debate their ideas. Presentations are entertaining and dynamic and include cutting edge interactive games and open discussion. In 2013, four Ar events and one SeminAr event took place at the Champalimaud Auditorium. The first event of this vibrant series was dedicated to Learning and Education.

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.

Organisers: Anna Hobbiss, Tiago Marques, Gil Costa, Bruno Afonso, Eric Dewitt, Ekaterina Vinnik, Scott Rennie, Rita Venturini, André Mendonça, Maria Vicente, Pedro Ferreira, Ana Pereira, Catarina Ramos, Simone Lackner, Roberto Medina, Nuno Calaim, Sara Matias

Ar event: Storytelling
May 22, 2013

AR EVENTS 2013



LEARNING & EDUCATION
Apr 4th

Speakers: Escola da Ponte, Domingos Fernandes, Paul Howard-Jones
MCs: André Mendonça, Maria Vicente, Gil Costa

STORYTELLING
May 22nd

Speakers: Jonathan Gottschall, Hélia Correia, Anna Hobbiss
MCs: Pedro Ferreira, Ana Pereira

MATH SENSE: EASIER THAN YOU THINK
Oct 17th

Speakers: Nuno Calaim (with Eric DeWitt), Richard Bisk, Ana Rita Pires
MCs: Roberto Medina, Nuno Calaim, Catarina Ramos

PLAYING WITH EMOTIONS: MUSIC & THE BRAIN
Nov 30th

Performers: Ensemble Bonne Corde
Speakers: Stephen Bull, Marta Moita
MCs: Scott Rennie

SEMINAR EVENTS 2013

THE CHEMISTRY BETWEEN US: THE SCIENCE OF LOVE AND IMPLICATIONS FOR NEW TREATMENTS FOR AUTISM
May 30th

Speakers: Larry Young
MCs: Léa Zinck, Cristina Márquez

COLLABORATIONS

FEATURING: SUPERHUMANS
Mar 26th

In parternship with Ciência Viva Pavilhão do Conhecmento, Lisbon, Portugal

INVEST IN OUR FUTURE - INVEST IN SCIENCE VIDEO CONTEST

As part of a movement against cuts in EU Science funding, a group of researchers from the Champalimaud Foundation in Lisbon, Portugal, has launched a short-video campaign called Invest in Our Future – Invest in Science. This campaign is part of a movement named no-cuts-on-research, which started with an Open Letter sent to the EU Heads of States and Governments, by 44 Nobel and Laureates and 6 Fields Medallists who stated their grave concern about the upcoming negotiations. Complementing this letter, a Petition started to circulate among research communities and the number of signatures has overcome 150.000.

The video contest attracted the participation of individuals across the world who found original ways to express their support in the cause of spreading the importance of science.

Contest Organisers: Catarina Ramos, Liad Hollender, Rita Venturini, Zachary Mainen
Ad design (above)**:** Rita Venturini and Liad Hollender
Banner design (below)**:** Gil Costa
Collaborators: Wolfgang Eppenschwandtner (Initiative for Science in Europe), Joana Barros (Associação Viver a Ciência)
Sponsors: Bayer, Caixa Geral de Depósitos

| Winning videos |

Jury selection:

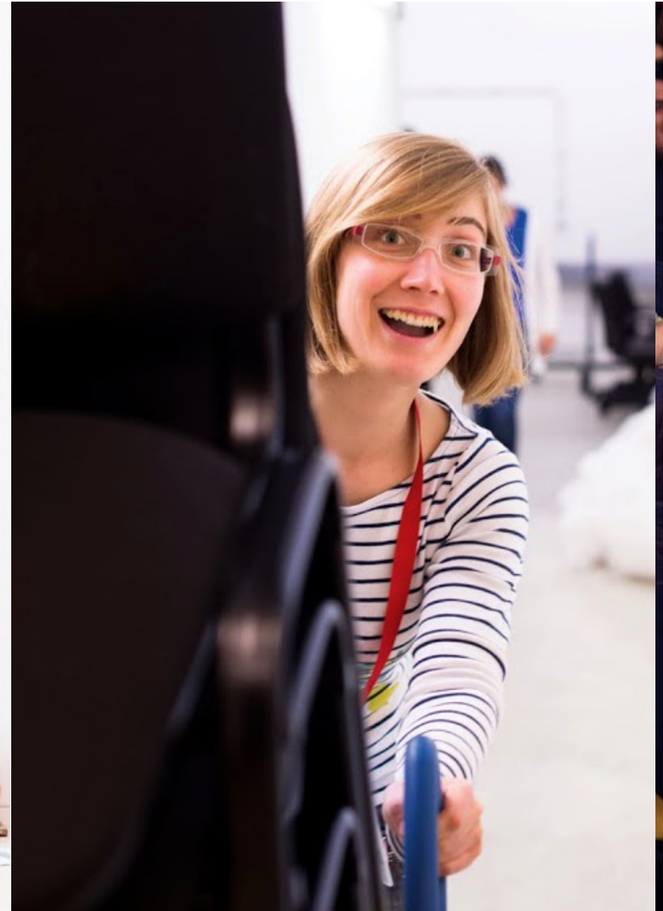
Why Does Science Matter?
By the Science in Society team at the British Science Association - Monica Lobo, Toby Shannon, Alice Taylor-Gee

When You Think About Science…
By Michal Maymon, Israel

Facebook voting:

Regenerated Story of Little Red Riding Hood.
By Luis Mendes, Wei Ji, Johanna Bolander, Kavin Karunratanakul, Maarten Sonnaert, Dennis Lambrechts, Sally Louis Homsy, Veerle Bloemen, liesbet geris, Astrid Van Hove, Liliana Moreira Teixeira. Begium

Video contest Jury Selection winners:
Top: *"When you think about science"* ; ***Bottom:*** *"Why Does Science Matter?"*



Taken from the Ar Event Storytelling:
"Storytelling is a powerful human drive. We spend our existence living the story of our lives, reshaping and telling it to ourselves and others. We read and write stories to create and remember. We paint and film them, bringing to life the most beautiful and singular details of the human experience. Sometimes, we even cover our bodies with them. But what are stories for? Why do we tell them? Why is storytelling such an integral part of our brains?"

AR Events
Left: *Storytelling, May 22*
Right: *Playing with emotions: Music & the Brain, November 30*

HIGH SCHOOL VISITS

Over 500 high school students visited the CCU in 2013, proving our Open Door Policy a worthwhile mission that will continue in 2014, 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. Due to the high number os requests, in Dec 2013, an online calendar for these visits to the CCU was implemented on the CF website.

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, Susana Lima

PARTICIPATION IN NOITE DOS PROFESSORES

2013

The CNP was invited to participate in this year's Noite dos Professores, organised by Pavilhão do Conhecimento. The event took place of the night of October 18th. A group of volunteers from the CNP included PhD students, members of the CNP Administration Unit and Clinical research fellows. The goal of Teacher's Night was to provide teachers with exciting new ways to educate their students about science. Among many stations with demonstrations about geology, physics and chemistry, the CNP provided a unique point of view on neuroscience.

Exhibitors: Catarina Ramos, Pedro Ferreira, Ana Pereira, Andreia Cruz, Maria Inês Vicente, Rodrigo Abreu, Liad Hollender, Tânia Li Chen, Marta Camacho, Albino Oliveira-Maia, Ana Fernandes, Pedro Rodrigues.

PRESS OFFICE

The CNP Science Communication Office also manages requests from the Media and issues press releases regularly. In 2013, 28 press releases were produced, resulting in 133 mentions in the local Portuguese Media and international coverage. In addition, the Office mediated 21 requests from the Portuguese media, including requests for interviews of CNP faculty to various Portuguese Journals such as Expresso and television channels such as RTP. 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.

WEBSITE & NEWSLETTER

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 2013, over 50 indivudual news posts were published on the CNP website, with corresponding updates on the CNP facebook page. This increased online presence resulted in a rapid increase in the number of facebook followers and website visits.

OUTREACH BY INDIVIDUAL CNP MEMBERS

In addition to participation in CNP-organised outreach events, CNP members also make regular visits to schools and participate in public events on science-related matters. The Science Communication Office mediates the majority of these events. Below you can find a list of these events.

| January |

1st
EdgeArts exhibit
One, No One and One Hundred Thousand
Artist: Joana Ricou
Panel discussion: Ana Pereira and Marta Moita

| February |

2nd
Speaker: Domingos Henrique
'Scientist as a Profession'
Talk to Secondary School Students
Escola Salesiana Estoril

| March (Brain Awareness Week 2013) |

12th
Speaker: Pedro Ferreira
'Dos neurónios aos circuitos no cérebro: uma viagem com lasers e outras coisas improváveis.'
Ciência Viva Centre, Lousal

Speaker: Ana Rita Fonseca
'Cérebro meu, cérebro meu: quem é mais complexo do que eu?'
Escola Básica 2,3 Conde de Oeiras

13th
Speaker: Susana Lima
'Cérebro meu, cérebro meu: quem é mais complexo do que eu?'
Grémio de Instrução Liberal de Campo de Ourique, Lisbon

| April |

11th

Speaker and Panel Participant: Marta Moita

Tertúlias de Jornalismo e Literatura on Storytelling
FNAC, Centro Commercial Colombo

12th

Speaker: Rui Costa

'Brain, Action and Perception – Creation of individual repertoires.'
Cultrugest event for Centro de Arte e Comunicação, Lisbon

13th

Speaker: Zachary Mainen
Team: Eric DeWitt, Scott Rennuw, Rita Venturini, Samuel Viana , Catarina Ramos

'How science works and the challenges that we face to make it better.'
TEDxO'Porto2013, on Fusion, Porto

16th

Speakers and panel participants: Catarina Ramos, Maria Inês Vicente

Science and Culture Week Event discussion with ex-Minister of Education David Justino and the president of Ciência Viva, Rosalia Vargas.
Escola Secundária do Forte da Casa

| May |

5th

Collaborators: Marta Moita, Joe Paton

Making a short movie - *Concurso Saber Porquê: De que cor é o céu à noite?*

Mundo na Escola | Mundo na Escola is a programme from the Portuguese Ministry for Education and Science which aims at bridging the gap between schools and arts, sciences and literature

| June |

28th

Speaker: Rui Costa

Hipnose e Neurociência
Rua Abade Faria

To celebrate the scientific contributions of Abade Faria, a series of activities, organised by Pavilhão do Conhecimento - Ciência Viva. Rui Costa talked about Hypnotism and Neuroscience at a Tattoo shop at Rua Abade Faria, Lisbon

| August |

16th

Collaborators: Maria Inês Vicente, Pedro Ferreira, Catarina Ramos and Michael Orger

Semester at Sea - A group of 25 students from the *"Semester at Sea"* ship visit, a study-away program for university students run by the University of Virginia-USA visited the CCU

| October |

Noite dos Professors
TEDx Youth at Leiria | See more information at Sciencecalifragilistic section

| November |

11th

Collaborators: Rui Costa, Catarina Ramos, Pedro Ferreira

Launching of Video Contest together with Ciência Viva to promote neurosciences and the European Year of the Brain among high schools in Portugal

| December |

28th

Collaborators: Domingos Henrique, Tiago Marques, Ricardo Gonçalves and Rui Costa

Participation in the science fundraising initiative *"Maratona da Saúde"*

Teachers Night
October 18, 2013

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 -

CHAMPALIMAUD NEUROSCIENCE SYMPOSIUM

25 - 28 September 2013

Organisers:
Maria Luísa Vasconcelos and Christian Machens

Administrative Coordination:
CNP Administrative Unit

Sponsors:
Aralab Blackrock, Ultragene, Tecniplast, Zeiss, Charles River, Filsat, Linde Healthcare, Clever Systems, Science 4 You, Meditecno, Go Natural, Sutter Instruments, Banco Espirito Santo (BES), Soquímica.

Institutional Support:
Champalimaud Foundation, Fundação para a Ciência e a Tecnologia, Fundação Luso-Americana.

This conference exemplified the broad interests of the CNP. In this third edition, eighteen invited speakers and five selected speakers

covered a wide range of topics in neuroscience. The talks together with the poster sessions, that took place every afternoon, generated lively discussions. Around 300 participants had an opportunity to discuss theoretical, cognitive molecular, genetic and ethologic approaches to neuroscience. The meeting provided an opportunity for the emergence of fresh ideas and new perspectives on the work of each participant.

List of Speakers:

Eve E. Marder (Brandeis University, USA)
Post Connectome Analyses of Circuit Dynamics: Variability, Modulation and Compensation in a Rhythmic Neuronal Circuit

Dora Angelaki (Baylor College of Medicine)
Optimal integration of sensory evidence: Building blocks and canonical computations

Richard Axel (Columbia University/HHMI)
Order from disorder: Representations of olfactory information in the cortex

Herwig Baier (Max Plank Institute of Neurobiology)
Modular control of behaviour in zebrafish

Mateo Carandini (University College London)
Circuits for summation and division in mouse visual cortex

Thomas Clandinin (Stanford University)
Dissecting the circuits that detect visual motion in Drosophila

Martha Constantine-Paton (Massachusetts Institute of Technology)
LTP/LTD: A link between activity-dependent development of neural circuits and behaviour

Catherine Dulac (Harvard University/HHMI)
New insights into genomic imprinting in the adult and developing brain

Michale Fee (Massachusetts Institute of Technology)
A model of basal ganglia function, inspired by the songbird
Susana Lima (Champalimaud Neuroscience Programme)
Mate choice in the house mouse

Marta Moita (Champalimaud Neuroscience Programme)
You are not alone: Fear in the context of social interactions

Tirin Moore (Stanford University/HHMI)
Compression of visual space in prefrontal cortex during eye movement

Hitoshi Okamoto (Riken Brain Science Institute)
The roles of the habenula in escape and aggression

Steven Reppert (University of Massachusetts)
Neurobiology of monarch butterfly migration

Timothy Ryan (Cornell University)
A link between metabolic state and cognitive state forged at the nerve terminal

Peter Scheiffele (Basel University)
Molecular diversity and synaptic functions of the neuroligin-neurexin adhesion system

Stefan Schuster (University of Bayreuth)
Prey catching in archerfish: A neurobiological bonanza

Gina Turrigiano (Brandeis University)
Firing rate homeostasis in awake freely behaving rodents

Scott Waddell (University of Oxford)
Reward, motivation and dopamine in the fruit fly

10TH NATIONAL CONGRESS OF ETHOLOGY

24 - 25 October 2013

Organisers:
Susana Lima and Marta Moita

Administrative Coordination:
Philipp Tsolakis, Catarina Ramos

Sponsors:
Imexsa, Monte Selvagem, Delta Cafés, Banco Espirito Santo (BES), Science 4 You, Sumol + Compal, Parque Biológico Gaia

Institutional Support:
Portuguese Ethology Society, Champalimaud Foundation

This meeting brought together scientists from the several fields afore mentioned, including ecology, evolution, development, physiology, psychology and neuroscience, spanning a wide range of model organisms, from invertebrates to vertebrates. We aim to present an integrated overview of animal behaviour, by bringing together investigators and students working in Portugal and abroad. Over two days we had four keynote lectures by internationally distinguished speakers, 24 talks selected from abstract submission and two poster sessions, providing ample opportunity for formal an informal exchange of ideas.

List of Speakers:

Regina Macedo (Universidade de Brasília)
Flights of fancy: sexual selection in a Neuotropical songbird

Chris Braun (Hunter College)
Soundscapes and the evolution of hearing: a case using Malagasy ad South Asian Cichlids.

Eugenia Chiappe (Champalimaud Neuroscience Programme)
Motion vision in walking flies

Susana Carvalho (Oxford University)
Primate archaeology, an interdisciplinary ethology: why does it matter?

NEW BRAIN TECHNOLOGIES: A ROAD MAP FOR PORTUGAL

26 June 2013

Organisers:
Zachary Mainen, Rui Costa

Administrative Coordination:
Inês Soeiro, Catarina Ramos, Liad Hollender

The Fundação para a Ciência e Tecnologia and the Champalimaud Foundation's Neuroscience Programme hosted a workshop entitled "New Brain Technologies: A roadmap for Portugal." The aim of this workshop is to present the Human Brain Project (HBP) Flagship, as well as the available details about Funding Calls expected this Autumn and in the beginning of the next year. Further discussions and breakout sessions were aimed to identify national teams with potential to participate in the activities of this Flagship in the future and identify the best way to promote this participation.

FUTURE OF ULTRA HIGH FIELD SMALL ANIMAL MAGNETIC RESONANCE TECHNOLOGY

7 - 8 November 2013

Organisers:
Zachary Mainen, Celso Matos

Administrative Coordination:
Inês Soeiro, Alexandra Piedade

What are the challenges and potentials of MRI technology to drive breakthroughs in brain and cancer imaging over the next 10-15 years? The goal of the workshop was to obtain strategic advice in this field, in order to identify opportunities to invest in this area. A panel of experts was consulted for their views on the potentials of this technology for research, particularly in the areas of neuroscience and/or oncology.

3º CONGRESS OF TUBEROUS SCLEROSIS

17 - 18 November 2013

Organisers:
The Association for Tuberous Sclerosis in Portugal, Inbal Israely

Administrative Coordination:
TS Association in Portugal, Liad Hollender, Catarina Ramos

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.

NEUROSEEKER GENERAL MEETING & WORKSHOP ON ADVANCED ELECTRODE TECHNOLOGY

27 - 28 June 2013

Organiser:
Adam Kampff

Administrative Coordination:
Tânia Li-Chen

The workshop was attended by 50 international participants, representing 12 EU and international projects, all developing hardware and software techniques for the acquisition and analysis of neural activity with advanced electrode technology. The full day meeting consisted of short presentations of each project followed by lively question and answer debates, which extended into a late afternoon break-out session, an informal reception, and the conference dinner. A number of the discussions arose between the participants and

NeuroSeeker, some of which (HHMI, Open-Ephys, Magnetrodes) have already lead to concrete collaborations between these related, synergistic activities. Furthermore, the main consensus at the meeting was the need to develop standard validation and test protocols such that improvements in recording technology could be compared across laboratories and experiments. A test plan, coordinated by HHMI with NeuroSeeker and other groups, is currently being developed and finalized in the preparation for the arrival of the first advanced probes during 2014. Furthermore, a report on developments within the 'Open-Ephys' project, an open source hardware and software initiative to develop inexpensive yet powerful electrophysiology tools, has led to a coordination of their technology with that developed throughout NeuroSeeker and has facilitated the adoption of 'Open-Ephys' hardware/software systems by a number of partners within NeuroSeeker for preliminary experiments.

HIPPOCAMPUS AND DECISION MAKING: AN ADVANCED COURSE

2 - 6 December 2013

Organisers:
Niccolò Bonacchi, Mert Erginkaya, Marina Fridman, Pavel Itskov, Nuno Loureiro, Marta Moita, Ekaterina Vinnik, Hedi Young

It seems natural that decisions, which depend so much on context and experience, must rely critically on the part of the brain where such information is stored, yet this function of the hippocampus is rarely discussed. Furthermore, actions are organised in space, and the spatial component of action planning also crucially involves the hippocampus. With the help of five invited lecturers from Europe and the U.S., we explored this much-overlooked aspect of the hippocampus.

List of Invited Speakers:

Francesco Battaglia (Donders Centre for Neuroscience)
Cell assemblies and cortico-hippocampal communication

David Foster (Johns Hopkins University)
The role of the hippocampus in navigational learning and decision- making

David Redish (University of Minnesota)
Mental time travel (past [memory] and future [planning])

David Robbe (Mediterranean Institute for Neurobiology)
The hippocampus beyond the cognitive map: Possible functions in episodic memory and time perception

Loren Frank (University of California)
How can a single circuit do many things?

Marta Moita (Champalimaud Neuroscience Programme)
Introduction to Hippocampus

CNP COLLOQUIA

2013

Organisers:
Christian Machens, Cristina Marquez, Tiago Monteiro, Maria Inês Vicente

Hedderik van Rijn (University of Groningen, The Netherlands)
Cross-fertilization between Computational Modeling and the Neurosciences
January 27, 2013

Javier Medina (The University of Pennsylvania, USA)
Turn on the light; turn off purkinje cells…. And blink!
March 7, 2013

Henry Yin (Duke University Medical Centre, USA)
The role of dopamine in behaviour
March 8, 2013

Cynthia Moss (University of Maryland, USA)
Multisensory processes guide 3-D spatial navigation in echolocating bats
March 21, 2013

Stephen Shea (Cold Spring Harbor Laboratory, Stony Brook University, USA)
Olfactory and auditory social communication in mice
April 2, 2013

Scott Sternson (Howard Hughes Medical Institute, Janelia Farm Research Campus)
Deconstruction of neural circuits for hunger
April 4, 2013

Allan Hobson (Beth Israel Deaconess Medical Center; Massachusetts Mental Health Center, USA)
Dream Consciousness
April 9, 2013

Massimo Scanziani (University of California San Diego, Howard Hughes Medical Institute)
Cortical circuits of Vision
April 11, 2013

Ilan Golani (Tel Aviv University, Israel)
Is mouse exploratory behaviour recursive?
April 11, 2013

Brett Mensh (Janelia Farm Research Campus, USA)
Maximizing the impact of your grants and papers
April 26, 2013

Peter Latham (Gatsby Computational Neuroscience Unit, University College London, UK)
Olfaction as probabilistic inference
May 2, 2013

Larry Young (Emory University, USA)
The Neurobiology of Social Bonding
May 30, 2013

Alvaro Pascual-Leone (Berenson-Allen Center for Noninvasive Brain Stimulation;Beth Israel Deaconess Medical Center; Harvard Medical School, USA) *Combining Brain Imaging, Neurophysiologic Techniques and Noninvasive Brain Stimulation to Understand A Changing Brain*
June 6, 2013

Gordon Fishell (New York University, USA)
The Role of Genetic Programs and Activity in the Development of Cortical Interneuron Diversity
June 27, 2013

Michael Platt (Duke University, USA)
Charity and Deception in the Brain
July 11, 2013

Stephen Lisberger (Howard Hughes Medical Institute; Duke University, USA)
Cellular and circuit mechanisms for cerebellar motor learning
July 25, 2013

Ed Callaway (Salk Institute for Biological Studies, USA)
Systems Neurobiology Laboratories, Salk Institute for Biological Studies
September 5, 2013

Michael Brecht (Berlin School of Mind and Brain, Bernstein Center for Computational Neuroscience)
A grid cell grid?
Semptember 12, 2013

David Redish (University of Minnesota, USA)
Evaluation during deliberation as covert representations of reward
September 19, 2013

Maneesh Sahani (Gatsby Computational Neuroscience Unit University College London, UK)
Inferring population dynamics from ensemble neuronal activity
October 10, 2013

Jeff Magee (HHMI Janelia Farm Research Campus, USA)
Circuit level computations in the neocortex and hippocampus
October 17, 2013

Michael J. Spivey (University of California, Merced, USA)
Online links between perception and higher cognition
October 31, 2013

Alan P. Koretsky (National Institute of Neurological Disorders and Stroke, USA)
Localization of Synaptic Sites of Cortical Plasticity by MRI
November 6, 2013

Matthew Botvinick (Princeton University, USA)
Hierarchical reinforcement learning
November 21, 2013

Loren Frank (University of California, San Francisco, USA)
Neural substrates of memory retrieval and decision-making
December 5, 2013

Robert Datta (Harvard Medical School, USA)
Sensors and Actuators for Smell
December 12, 2013

PRESENTATIONS AND MEETING ORGANISED AT INTERNATIONAL INSTITUTIONS

- PRESENTATIONS -

Megan Carey
Talk Presentations

18/2/2013
The cerebellar circuit: from synapse to behaviour
JORTEC Symposium on Biomedical Engineering, Faculty of Science and Technology, Universidade Nova de Lisboa, Portugal

14/8/2013
Cerebellar contributions to coordinated locomotion in mice
Gordon Research Conference on the Cerebellum, New London, NH, USA.

16/9/2013
Cerebellar contributions to coordinated locomotion in mice
Instituto Medicina Molecular (Keynote lecture, 10th Anniversary Postdoctoral Symposium), Lisbon, Portugal.

17/10/2013
The cerebellar circuit: from synapse to behaviour
École des Neurosciences de Paris Student Retreat (Keynote lecture), Normandy, France.

13/11/2013
Instructive signals for locomotor adaptation in mice
Society for Neuroscience Annual Meeting (Minisymposium on Teaching Signals), San Diego, CA, USA.

Megan Carey
Poster Presentations

Albergaria C, Silva NT, Carey MR. *Is endocannabinoid signaling required for cerebellum-dependent learning?* Gordon Research Conference on the Cerebellum 2013, New London, NH, USA.

Albergaria C, Silva NT, Carey MR. *Is endocannabinoid signaling required for cerebellum-dependent learning?* Howard Hughes Medical Institute Investigators meeting 2013, Ashburn, VA, USA.

Albergaria C, Silva NT, Carey MR. *Is endocannabinoid signaling required for cerebellum-dependent learning?* Champalimaud Neuroscience Symposium 2013, Lisbon, Portugal.

Ana S. Machado, João Fayad, Carla Matos, Megan R. Carey. *Cerebellar contributions to mouse locomotion revealed by the LocoMouse tracking system.* Champalimaud Neuroscience Symposium 2013, Lisbon, Portugal.

Eugenia Chiappe

Talk Presentations

24/10/2013
Motion vision in walking flies
10th Meeting of Portuguese Society of Ethology, Lisbon, Portugal

Rui Costa

Talk Presentations

5/2013
Generating and shaping novel action repertoires
Janelia Conference "Temporal Dynamics in Learning: Networks & Neural Data." Ashburn, VA, USA

8/2013
Endocannabinoids and Habit Formation
Gordon Research Conference, Cannabinoid Function in the CNS. Waterville Valley, NH, USA

9/2013
Generating and shaping novel action repertoires
UC Berkeley Neuroscience Seminar Series. Berkeley, CA, USA

9/2013
Generating and shaping novel action repertoires
EPFL SV- Life Science Symposium "Motor Control - from neural circuits and diseases to neuroprosthetics. " Lausanne, Switzerland

10/2013
Generating and shaping novel action repertoires
The Assembly and Function of Neural Circuits. Ascona, Switzerland.

11/2013
Generating and shaping novel action repertoires
MPI Florida. Florida, US.

Rui Costa

Poster Presentations

Alves da Silva J, Tecuapelta F, Paixão V, Costa RM. *Exploring the role of SNC dopaminergic neurons in the initiation of self paced actions.* Chamaplimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Tecuapetla F, Jin X, Lima, Costa RM. *Basal ganglia contribution to action initiation and action performance.* Chamaplimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Mutlu S, Feliciano C, Tecuapetla F, Costa RM. *Intrinsic properties and signal dynamics of basal ganglia output neurons.* Chamaplimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Rachinas-Lopes P, Paixão VB, Gomez-Marin A, dos Santos ME, Costa RM. *Inertial Sensor and Tracking System as a New Method to Study the Behaviour of Dolphins.* Chamaplimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Cao V, Costa RM, Wang K. *Experience-dependent activation of Arc expression in individual frontal cortical neurons during motor training.* Chamaplimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Castro AC, Oliveira-Maia A, Costa RM. *NMDA receptor deletion in interneurons alters motor and instrumental learning in mice.* Chamaplimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Afonso C, Paixão VB, Costa RM. *Host exploratory and risk behaviours are modified during parasitic infection.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Oliveira RF, Costa RM. *Neural substrates of accuracy in motor skills.* Society For Neuroscience Annual Meeting 2013. San Diego, CA, USA.

French CA, Feliciano C, Correia M, Paixão VB, Jin X, Fisher SE, Costa RM. *Differential contributions of Foxp2 to motor-skill learning.* Society For Neuroscience Annual Meeting 2013. San Diego, CA, USA.

Gremel CM, Luo G, Lovinger D, Costa RM. *Endocannabinoid signaling in orbitofrontal cortex modulates habit formation.* Society For Neuroscience Annual Meeting 2013. San Diego, CA, USA.

Santos FJ, Costa RM. *Cortical and striatal dynamics during operant motor skill learning.* Portuguese Society for Neuroscience meeting. 2013. Luso, Portugal.

Santos FJ, Costa RM. *Cortical and striatal dynamics during operant motor skill learning.* Temporal Dynamics in Learning: Networks and Neural Data. 2013. Janelia Farm Research Campus - Ashburn, USA.

Mutlu S, Tacuapetla F, Feliciano C, Costa RM. *Mapping dorsomedial and dorsolateral striatal circuits: Anatomical data suggesting parallel loop organisation in mouse basal ganglia.* Neurobiology of Action 2013, Milano, Italy.

Martins GJ, Vaz A, Costa RM. *Motor and instrumental learning in mice with interneuron NMDA receptor deletion.* Sociedade Portuguesa de Neurociencias 2013. Luso, Portugal.

Inbal Israely

Talk Presentations

11/6/2013 (Presentation by Israely Lab group member: Yazmín-Cortés)
Spine shrinkage and elimination via mGluR-induced LTD: implications for long-term memory storage.
Spring Hippocampal Research Conference. Taormina, Italy

5/12/2013
Activity dependent restructuring of synaptic inputs
Long-term potentiation: enhancing neuroscience for 40 years.' Satellite Meeting at The Royal Society, Kavli Research Centre. London, UK

Adam Kampff

Talk Presentations

12/2/2013
The Present and Future of Neural Recording Devices
BIOSTEC 2013, Keynote Lecture. Barcelona, Spain

18/2/2013
The Present and Future of Neural Recording Devices
JORTEC 2013. Caparica, Portugal

25/7/2013
Children on Drugs:
How common behaviour medications affect the (young) brain?
NYSASN Summer Enrichment Academy. Grand Island, NY, USA

16/9/2013
Moving with motor cortex: Controlling behaviour in unpredictable environments
European Visual Cortex Meeting. Zagreb, Croatia

30/10/2013
Control of behaviour in unpredictable environments:
Moving with Motor Cortex
Max Planck Institute for Neurobiology. Munich, Germany

28/11/2013
Moving with cortex: New techniques for studying behaviours that require motor cortex
SWC - University College of London. London, UK

Susana Lima
Poster Presentations

10/2013
Nomoto K, Lima S. *Social signals in the ventromedial hypothalamus of female mice: influence of the reproductive cycle. Hormones and Behaviour Conference.* Janelia Fram, HHMI, USA.

Christian Machens
Talk Presentations

25/3/2013
Dynamics of the oculomotor integrator revealed by instantaneous optogenetic perturbations
Instituto de Medicina Molecular, Lisbon, Portugal

14/5/2013
On the optimality and robustness of neural tuning
Janelia Farms Conference "Temporal Dynamics in Learning." Washington DC, USA

9/5/2013
Efficient Coding and Balanced Networks: A unification
Carnegie Mellon University. Pittsburgh, USA

17/5/2013
Efficient Coding and Balanced Networks: A unification
Columbia University. New York, USA

30/5/2013
Some new insights on neural population tuning
Workshop "Noise in decision making", IDIBAPS, CRM, UPF Barcelona. Barcelon, Spain

12/7/2013
Efficient Coding and Balanced Networks: A unification
University of Bielefeld. Bielefeld, Germany

17/7/2013
Working Memory: What needs to be explained?
Computational Neuroscience Meeting (Workshop on "Neural Mechanisms of Working Memory Limits"). Paris, France

15-16/8/2013
Efficient Coding
Advanced Course in Computational Neuroscience (IBRO/FENS Summer School). Poznan, Poland

16/10/2013
Statistical commonalities in population responses across brain areas
Columbia University, Workshop on "quantifying structure in large neural datasets." New York, USA

5/12/2013
Efficient Coding and Balanced Networks: A unification
EPFL Lausanne. Lausanne, Switzerland

9/12/2013
Efficient Coding
FMI Basel, Course on Computational Biology. Basel, Switzerland

Zachary Mainen
Talk Presentations

24/1/2013
Origins and use of uncertainty in decision-making
Bernstein Center for Computational Neuroscience. Tubingen, Germany

15/2/2013
The neural dynamics of waiting and giving up in the rat premotor cortex
Institute of Neuroinformatics, University of Zurich. Zurich, Switzerland

7/3/2013
The origins and use of decision confidence
3rd Latin American School for Education, Cognitive and Neural Sciences. Comandatuba, Brasil

19/4/2013
Neural circuits for spontaneous action timing in the frontal cortex
1st European Neuroscience Conference by Doctoral Students. Bordeaux, France

15/5/2013
Neural circuits for spontaneous action timing in the frontal cortex
Temporal Dynamics in Learning: Networks and Neural Data. HHMI Janelia Farm Research Campus, USA

26/5/2013
Mendonça AG, Vicente MI, deWitt EJ, Pouget A, Mainen ZF. *Uncertainty in the brain as a two-step problem: how continuous learning may generate errors.* Annual Meeting for Gulbenkian Students. Seia, Portugal.

30/5/2013
Contribution of online learning to variability in perceptual decisions
Noise in decision-making. Barcelona, Spain

27/7/2013
Neural circuits for spontaneous action timing in the frontal cortex
Institute of Neuroscience, Shanghai, China

10/10/2013
What can experimental systems neuroscience teach us about studying social systems?
A Multilevel Approach to Distributed Cognition. Cascais, Portugal

23/10/2013
Neural mechanisms of the timing of actions
Yale University. New Haven, CT, USA

24/10/2013
Costa GM, Mainen ZF. *Interplay between value and confidence in a olfactory guided decision.* Sociedade Portuguesa de Etologia. Lisbon, Portugal.

Zachary Mainen
Poster Presentations

DeWitt EJ, Mendonça AG, Kepecs A, Mainen ZF. *Confidence based learning in a perceptual task: How uncertainty and outcome influence choice.* Cosyne. Arizona, USA.

Costa GM, Mainen ZF. *Interplay of confidence and value in the transformation of olfaction to action.* Cosyne. Arizona, USA.

Fonseca AR, Mainen ZF. *Planning and selecting between multiple action sequences in a multiple alternative non-forced choice task.* EPFL SV- Life Science Symposium. Lausanne, Switzerland.

Venturini R, Johnson H, Mainen ZF. *Feedback manipulation affects confidence in decision making.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Mendonça AG, Vicente MI, Pouget A, Mainen ZF. *Crystalized learning as a suboptimal strategy that degrades odor categorization performance.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Murakami M, Vicente MI, Costa GM, Mainen ZF. *Neural dynamics of waiting and giving up in the rat secondary motor cortex.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Correia PA, Valente SS, Lima SQ, Mainen ZF. *Serotonergic modulation of sexual behaviour.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Lottem E, Lorincz M, Dugué G, Mainen ZF. *Serotonergic modulation of sensory information processing in the piriform cortex.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Vicente MI, Mendonça AG, Mainen ZF. *Task-dependent speed accuracy-tradeoffs in olfaction.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Costa GM, Mainen ZF. *Interplay between value and uncertainty in the olfactory striatum.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Fonseca M, Murakami M, Mainen ZF. *Serotonergic modulation of waiting behaviour.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Matias S, Dugué G, Lottem E, Audero E, Vassilevskaia T, Mainen ZF. *Long-term monitoring of genetically defined neuronal populations in freely behaving rodents through an optical fiber.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Marta Moita
Talk Presentations

28/9/2013
You're not alone: fear in the context of social interactions
Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal

10/10/2013
You're not alone: fear in the context of social interactions
ESCON 2013 Workshop: A Multilevel Approach to Distributed Cognition. Cascais, Portugal

2013 (Presentation by Moita Lab group member: Ana Pereira)
Auditory Cues in Social Transmission of Fear
Riken Summer School. Tokyo, Japan

2013 (Presentation by Moita Lab group member: Elizabeth Rickenbacher)
Oxytocin in the Central Nucleus of the Amygdala Mediates Social Buffering of Fear.
The Nathan Kline and NYU Emotional Brain Institute. New York, NY, USA

7/2013 (Presentation by Moita Lab group member: Scott Rennie)
Coordination in Rats: The use of game theory to study the proximal mechanisms of cooperation.
Cold Spring Harbor Asian Conferences: Computational and Cognitive Neuroscience. Beijing, China

10/2013 (Presentation by Moita Lab group member: Scott Rennie)
Coordination in Rats: The use of game theory to study the proximal mechanisms of cooperation.
10th National Congress of Ethology. Lisbon, Portugal

Marta Moita
Poster Presentations

Cruz A. *A Blast from the past: how prior experience modulates transmission of fear.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Cruz A. *A Blast from the past: how prior experience modulates transmission of fear.* 10th National Congress of Ethology. Lisbon, Portugal.

Pereira A. *Auditory Cues in Social Transmission of Fear.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Pereira A. *Auditory Cues in Social Transmission of Fear.* FENS/IBRO Summer School: Causal Neuroscience: Interacting with Neural Circuits. Bertinoro, Italy.

Pereira A. *Auditory Cues in Social Transmission of Fear.* 10th National Congress of Ethology. Lisbon, Portugal.

Rickenbacher E. *Misery Really Does Love Company: Oxytocin in the Central Nucleus of the Amygdala Mediates Social Buffering of Fear.* ECNP Congress. Barcelona, Spain.

Rickenbacher E. *Misery Really Does Love Company: Oxytocin in the Central Nucleus of the Amygdala Mediates Social Buffering of Fear.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Rickenbacher E. *Oxytocin in the Central Nucleusof the Amygdala Mediates Social Buffering of Fear.* ECNP Workshop School. Nice, France.

Rennie S. *Coordination in Rats: The use of game theory to study the proximal mechanisms of cooperation.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Michael Orger
Talk Presentations

19/3/2013
Whole brain imaging of neural circuit activity in behaving zebrafish
Max Planck Institute of Neurobiology. Munich, Germany

11/7/2013
Whole brain imaging of neural circuit activity in behaving zebrafish
Vienna Biocenter. Vienna, Austria

Joe Paton
Talk Presentations

3/2013 (Presentation by Paton Lab group member: Thiago Gouvea)
On embodied cognition, the basal ganglia, and neural codes for time
Internal seminar Universidade Federal do ABC. São Paulo, Brasil

5/2013
Networks don't play chess
Janelia Farm Research Campus. Confernece of temporal dynamics in learning. Ashburn, VA. USA

Joe Paton
Posters Presentations

Gouvea T, Monteiro T, Soares S, Paton JJ. *On embodied cognition, the basal ganglia, and neural codes for time.* ENCODS conference. Bordeaux, France.

Soares S, Atallah B, Monteiro T, Gouvea T, Paton JJ. *Mice perform action sequences that predict choice during temporal discrimination.* Soceity for Neuroscience Annual Meeting 2013. San Digo, CA, USA.

Leopoldo Petreanu
Talk Presentations

12/9/2013
Shining light on cortical circuits
Instituto Superior Técnico. Lisbon, Portugal

29/11/2013
The structure and function of cortico-cortical connections
Instituto de Neurociencias. Alicante, Spain.

Alfonso Renart
Talk Presentations

30/5/2013
Competitive Dynamics During Spontaneous Activity
ESF Workshop "Noise in Decision Making." Barcelona, Spain

24/9/2013
Spontaneous Dynamics of Cortical Circuits during Activated States
Bernstein Conference. Tubingen, Germany

Carlos Ribeiro
Talk Presentations

16/3/2013
Gourmet flies - using winged invertebrates to understand the brain
Invited speaker at the meeting of the Portuguese Biomedical Sciences students (IV Jornadas Nacionais de Ciências Biomédicas). Averio, Portugal

16/4/2013 (Presentation by Ribeiro Lab group member: Samuel J Walker)
How Internal States Modulate Sensory Processing in Drosophila
Max Planck Institute for Neurobiology, Munich, Germany - FLiACT Annual Meeting. Munich, Germany

18/4/2013
The gourmet fly - the molecular and neuronal basis of nutrient decisions in Drosophila
Invited speaker at the Institut of Functional Genomics Lyon (IGFL), Lyon, France

3/5/2013
Gourmet flies - Essential and non-essential decisions in Drosophila
Invited speaker at the second nutritional homeostasis workshop at the LIMES Institute, University of Bonn, Germany

26/7/2013
Gourmet flies – Using winged invertebrates to understand how the brain and the body interact
Key note speaker at the 7th PhD student's retreat of the Max-Planck-Institute of Immunobiology and Epigenetics in Freiburg, Münstertal, Germany

15/8/2013
Gourmet flies – Essential and non essential decisions in Drosophila
Selected speaker at the third Junior European Drosophila Investigator meeting, Cumberland Lodge, UK

19/10/2013
Using a holidic medium to study nutrient homeostasis in Drosophila
Selected talk at the European Drosophila Conference in Barcelona, Spain

10/2013 ((Presentation by Ribeiro Lab group member: Verónica M Corrales)
Elucidating the computational strategies behind nutritional decisions in Drosophila
CSHL Neurobiology of Drosophila Meeting. Cold Spring Harbor, USA

10/2013 (Presentation by Ribeiro Lab group member:
Verónica M Corrales; Awarded "Best Talk")
Elucidating the computational strategies behind nutritional decisions in Drosophila
Portuguese Neuroethology Meeting. Lisbon, Portugal

10/2013 (Presentation by Ribeiro Lab group member: Pavel M Itskov)
FlyPAD : high throughput and temporal resolution feeding sensor for flies.
CSHL Neurobiology of Drosophila Meeting. Cold Spring Harbor, USA

10/2013 (Presentation by Ribeiro Lab group member: Pavel M Itskov)
FlyPAD : high throughput and temporal resolution feeding sensor for flies.
Portuguese Neuroethology Meeting. Lisbon, Portugal

Carlos Ribeiro
Poster Presentations

Corrales VM, Faisal AA, Ribeiro C. *Poster: Elucidating the computational strategies behind nutritional decisions in Drosophila.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Leitão-Gonçalves R., Fioreze G. T., Francisco A. P., Piper M. D., Ribeiro C. *Different dietary components have drastically different effects on feeding decisions and nutrient homeostasis.* CSHL Neurobiology of Drosophila Meeting. Cold Spring Harbor, USA.

Pavel M. Itskov, Matthieu Pasquett, Jose-Maria Moreira, Ekaterina Vinnik, Goncalo Lopes,Steve Safarik, Michael Dickinson and Carlos Ribeiro. *FlyPAD : high temporal resolution feeding sensor for flies.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Walker SJ, Ribeiro C. Modulation of Sensory Processing & Behaviour by Mating in Drosophila. *FLiACT Workshop: Emerging Techniques to Map & Functionally Characterise Neural Circuits in Drosophila.* Ashburn, USA.

Herbert SL, Ribeiro C. *Neuronal nutrient sensing in Drosophila feeding decisions.* Champalimaud Neuroscience Symposium 2013. Lisbon, Portugal.

Maria Luísa Vasconcelos
Talk Presentations

1/3/2013
Unravelling the circuit of CO2 avoidance in Drosophila melanogaster
XiV jornadas de Biologia Aplicada, Univ. Minho. Braga, Portugal.

27/5/2013
Circuits of Innate behaviours
Cognition, emotion and behaviour: the brain at work, University of Porto. Porto, Portugal.

19/9/2013
unravelling the circuit of CO2 avoidance in Drosophila melanogaster
Collége de France. Paris, France.

Maria Luísa Vasconcelos
Poster Presentations

Herrmann D, Dias S, Vasconcelos ML. *An intersectional approach to assess the requirement of subsets of apterous-neurons in receptivity.* Congress of the Portuguese Society of Ethology. Lisbon, Portugal.

Aranha MM, Souza A, Santos M, Gyenes B, Dias S, Vasconcelos ML. *Identification of neurons controlling female sexual behaviour.* Congress of the Portuguese Society of Ethology. Lisbon, Portugal.

Domingos Henrique
Talk Presentations

25/10/2013
From ES cells to Neurons
2nd Joint Meeting SPDB/SEBD Meeting. Lisbon, Portugal.

Domingos Henrique
Poster Presentations

Abranches E, Guedes A, Pezzarossa A, Henrique D. *The role of Nanog in pluripotency network regulating Embryonic Stem Cells.* 2nd Joint Meeting SPDB/SEBD Meeting. Lisbon, Portugal.

Gaspar C, Rosa AI, Ferreira S, Ramos C, Henrique D. *Understanding cell fate decisions in the embryonic retina.* 2nd Joint Meeting SPDB/SEBD Meeting. Lisbon, Portugal.

Costa A, Juniat S, Gale J, Daudet N, Henrique D. From Embryonic Stem Cells to Sensory Hair Cells: A Cell Reprogramming Approach. 2nd Joint Meeting SPDB/SEBD Meeting. Lisbon, Portugal.

Barbacena P, Ramos C, Neves J, Henrique D. Unravelling the regulation of Dll4 expression and its function during embryonic neurogenesis. 2nd Joint Meeting SPDB/SEBD Meeting. Lisbon, Portugal.

Guedes A, Abranches E, Henrique D. Analysis of the dynamic properties of the pluripotency network in Embryonic Stem Cells. 2nd Joint Meeting SPDB/SEBD Meeting. Lisbon, Portugal.

Rui Oliveira

Talk Presentations

20-24/5/2013
Rapid regulation of gene expression in the zebrafish brain induced by perceived social interactions
15th Annual Meeting of The International Behavioural & Neural Genetics Society (IBANGS). Leuven, Belgium

3-5/7/2013
Cognitive appraisal mediates physiological and genomic responses to social information
3rd ToK CONFERENCE OF COMPCOG, "The Evolution of Social Cognition: Comparisons and integration across a wide range of human and non-human animal species." Vienna, Austria

4-8/8/2013
Integrating proximate and ultimate causes of social plasticity
BEHAVIOUR 2013 - Joint meeting of the 33rd International Ethological Conference (IEC) & the Association for the Study of Animal Behaviour (ASAB). Newcastle, UK

3-6/10/2013
Neuroendocrinology of social behaviour in tilapia
BARD (the United States – Israel Binational Agricultural R&D Fund) Workshop on "Perspectives in Endocrinology of Cichlids." Kibbutz Ein Harod, Ihud, Israel

3-6/10/2013
Neuroanatomy resources for a behavioural neuroendocrinology study model, the Mozambique tilapia (Oreochromis mossambicus)
BARD (the United States – Israel Binational Agricultural R&D Fund) Workshop on "Perspectives in Endocrinology of Cichlids." Kibbutz Ein Harod, Ihud, Israel

11-13/10/2013
Social competence as an ecological performance trait: proximate mechanisms and ultimate consequences
European Social Cognition Network (ESCON) Experts Workshop "A Multilevel Approach to Distributed Cognition." Cascais, Portugal

24-25/10/2013 (Presentation by Oliveira Lab group member: José M Simões)
Social odors conveying dominance and reproductive information induce rapid brain transcriptome changes in a cichlid fish
10th Meeting of the Portuguese Ethological Society. Lisbon, Portugal

24-25/10/2013 (Presentation by Oliveira Lab group member: Sara Cardoso)
Social network and reproductive success in a species with alternative reproductive tactics
10th Meeting of the Portuguese Ethological Society. Lisbon, Portugal.

5-6/12/2013
Searching for the social brain: neural and molecular mechanisms of social learning in zebrafish
ASAB Winter Conference 2013 "The Evolution of Behavioural Mechanisms." Zoological Society, London, UK

5-6/12/2013 (Presentation by Oliveira Lab group member: Magda Teles)
Socially driven changes in neural plasticity mediate behavioural flexibility
ASAB Winter Conference 2013 "The Evolution of Behavioural Mechanisms." Zoological Society, London, UK

20/12/2013 (Presentation by Oliveira Lab group member: Sara Cardoso)
Paternity estimates for male alternative reproductive tactics in a blenniid fish
9th Portuguese Meeting of Evolutionary Biology. Instituto Gulbenkian de Ciência, Oeiras, Portugal

Rui Oliveira

Poster Presentations

Messias JP, Paula JR, Grutter A, Oliveira RF, Bshary R, Soares MC. *The role of dopaminergic system in the modulation of the Indo-pacific bluestreak cleaner wrasse Labroides dimidiatus cooperative behaviour.* ASAB Winter Conference 2013 "The Evolution of Behavioural Mechanisms", Zoological Society, London, UK.

Gonçalves-de-Freitas, Almeida O, Oliveira RF. *Social instability promotes coupling between hormones and behaviour in a cichlid. XXXI* Annual Meeting of the Brazilian Ethological Society, University of São Paulo, Brasil.

Fernandes-de-Castilho M, Pinho JS, Oliveira RF. *Associative learning using alarm response in zebrafish.* XXXI Annual Meeting of the Brazilian Ethological Society, University of São Paulo, Brasil.

Pinho JS, Fernandes-de-Castilho M, Oliveira RF. *Classic and social fear conditioning in zebrafish.* X Congresso Nacional de Etologia, Fundação Champalimaud, Lisboa, Portugal. (BEST STUDENT POSTER AWARD.)

Abreu RA, Oliveira RF. *Social Eavesdropping in Zebrafish.* X Congresso Nacional de Etologia, Fundação Champalimaud, Lisboa, Portugal.

Teles MC, Oliveira RF. *Socially driven changes in neural plasticity mediate behavioural flexibility.* X Congresso Nacional de Etologia, Fundação Champalimaud, Lisboa, Portugal.

Messias JP, Paula JR, Grutter A, Oliveira RF, Bshary R, Soares MC. *The role of dopaminergic system in the modulation of the Indo-Pacific bluestreak cleaner wrasse Labroides dimidiatus cooperative behaviour.* X Congresso Nacional de Etologia, Fundação Champalimaud, Lisboa, Portugal.

Cardoso SC, Bshary R, Paitio JR, Mazzei R, Oliveira RF, Soares MC. *Ecological relevance determines Arginine-vasotocin influence on cleanerfish learning abilities.* X Congresso Nacional de Etologia, Fundação Champalimaud, Lisboa, Portugal.

Oliveira GA, Martins M, Fernandes A, Oliveira RF. *Hormonal response to an experimental emotion induction procedure.* X Congresso Nacional de Etologia, Fundação Champalimaud, Lisboa, Portugal.

Faustino F, Teles MC, Oliveira RF. *Effects of social environment and cortisol in adult neurogenesis in zebrafish.* X Congresso Nacional de Etologia, Fundação Champalimaud, Lisboa, Portugal.

Faustino A, Carneiro M, Godinho Ferreira M, Oliveira RF. *The role of ageing in behavioural and stress response in zebrafish.* X Congresso Nacional de Etologia, Fundação Champalimaud, Lisboa, Portugal.

Carneiro MC, Henriques CM, Faustino A, Oliveira RF, Godinho Ferreira M. *Aging is a consequence of telomere shortening in zebrafish.* Cold Spring Harbor Asia Conferences: Molecular Basis of Aging and Disease, Suzhou Dushu Lake Conference Center, China.

Oliveira RF, Gonçsalves DM, Fagundes T, Saravia J. *Life-history pathways associated with sequential reproductive tactics in the peacock blenny (Salaria pavo).* XIV Congress of the European Society for Evolutionary Biology, Lisbon, Portugal.

Cerqueira M, Millot S, Castanheira M, Gonçalves R, Oliveira RF, Martins C. *Psychological modulator of fish appraisal: how the predictability of appetitive and aversive stimuli modifies the behavioural responses of Gilthead sea bream (Sparus aurata).* BEHAVIOUR 2013 - Joint meeting of the 33rd International Ethological Conference (IEC) & the Association for the Study of Animal Behaviour (ASAB), Newcastle, UK.

Cardoso S, Paitio J, Mazzei R, Bshary R, Oliveira RF, Soares M. *Ecological relevance determines arginine vasotocin influence on cleanerfish learning abilities.* BEHAVIOUR 2013 - Joint meeting of the 33rd International Ethological Conference (IEC) & the Association for the Study of Animal Behaviour (ASAB), Newcastle, UK.

Messias JP, Paula JR, Grutter A, Oliveira RF, Bshary R, Soares MC. *The role of dopaminergic system in the modulation of the Indo-pacific bluestreak cleaner wrasse Labroides dimidiatus cooperative behaviour.* BEHAVIOUR 2013 - Joint meeting of the 33rd International Ethological Conference (IEC) & the Association for the Study of Animal Behaviour (ASAB), Newcastle, UK.

Paula J, Messias J, Grutter A, Oliveira RF, Bshary R, Soares M. *Serotonin Neuromodulation of Cooperative Behaviour in a Cleaner Fish.* BEHAVIOUR 2013 - Joint meeting of the 33rd International Ethological Conference (IEC) & the Association for the Study of Animal Behaviour (ASAB), Newcastle, UK.

Oliveira RF, Fernandes A, Oliveira T, Goncalves D, Oliveira G, Garcia-Marques T. *Testosterone and DHEA modulate the recognition of emotional faces.* Implications of Research on the Neuroscience of Affect, Attachment and Social Cognition Conference, University College of London, UK.

MEETINGS

3RD STEMBRYO MEETING

May 19 – 20, 2013

Organisers:
Domingos Henrique
Lisbon, Portugal.

International meeting on Stem Cells & Embryos.

5TH COMPUTATIONAL AND COGNITIVE NEUROSCIENCE SUMMER SCHOOL

July 6 - 24 ,2013
Beijing, China

Organisers:
Xiao-Jing Wang (New York University and NYU Shanghai, USA/China), Si Wu (Beijing Normal University, China), Upinder S Bhalla (Natl Ctr Biological Sci, Bangalore, India), Zachary F Mainen (Champalimaud Neuroscience Programme, Portugal)

The 4th Computational and Cognitive Neurobiology Summer School is going to be held in the campus of Beijing Normal University, in Beijing, China. The objective of this course is to train in Computational Neuroscience talented and highly motivated students and postdocs from Asia and other countries in the world. Applicants with either 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, in Computational Systems and Cognitive Neurosciences, with an emphasis on higher cognitive functions and their underlying neural basis. Modeling will be taught at multiple levels, ranging from single neuron computation, microcircuits and large-scale systems, to normative theoretical approach to brain functions. Matlab-based programming labs coordinated with the lectures will provide practical training in important computational methods.

ESCON (EUROPEAN SOCIAL COGNITION NETWORK) EXPERTS WORKSHOP ON "A MULTILEVEL APPROACH TO DISTRIBUTED COGNITION"

October 10 – 13, 2013
Lisbon, Portugal

Organisers:
Gün R. Semin (Utrecth University, Netherlands), Rui F. Oliveira (ISPA and IGC/CNP, Lisbon, Portugal)

The aim of this ESCON experts workshop was to approach the grounding of social behaviour from a multilevel perspective. In this perspective, an adequate explanation of social behaviour requires an understanding of the interplay between behaviour, bodily structure, social context, and environmental resources rather than a focus on the isolated study of individual cognitive functions such as attention, memory, or learning.

TOWARDS A COMMON FRAMEWORK TO STUDY THE FUNCTION OF THE INSECT CENTRAL COMPLEX

October 16 – 19, 2013
Meeting Center of Catalunia, Barcelona, Spain

Organisers:
Eugenia Chiappe (CNP), Matthieu Louis (Center for Genomic Regulation, EMBL-CRG Systems Biology Unit, Barcelona, Spain)

The session was organised to bring together novel colleagues working with and developing novel techniques to link circuit function with behaviour.

Champalimaud Neuroscience Symposium
Poster Session
September, 2013

TO PROMOTE COLLECTIVE ACHIEVEMENTS

BEYOND THOSE REACHABLE BY INDIVIDUAL SCIENTISTS OR LABORATORY GROUPS

2013 CNP ANNUAL RETREAT

Each spring, the busy corridors of the CNP empty, as all CNP members travel together to a unique location. There, they dedicate five days to getting reacquainted with each other's research and to simply having a good time together. Even though the retreat boasts a busy schedule of talks, poster sessions and discussions, along-side these scientific events run group activities, parties and quiet pool-side relaxation. This balance between scientific and social interaction, lays the foundation to the collaborative spirit, solidarity and scientific excellence that are the core of the CNP.

In 2013, the retreat was held once again at the Vila Galé Clube de Campo in Alentejo. This remote and beautiful location offered an ideal setting for introspection and reflection on the on-goings of the CNP.

This year, special cards were prepared for the retreat. Each CNP member had to produce one figure that described his or her work. These cards were then used in various games that helped CNP members to learn about the work of each other and to draw lines between different projects, producing a connectivity map.

CHAMPALIMAUD INTERNAL SEMINAR SERIES

As one of the means to creating an environment where individual researchers, in all career stages, are familiar with the work of each other, an event series called Champalimaud Internal Seminars Series (CISS) was created. Each week, two CNP researchers deliver a 30 minutes 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 at preparing and delivering oral presentations to large audiences.

LIFE @ CCU

Life @ CCU is a series of meetings designed to address new initiatives, concerns and needs of the CNP community. Meetings are conducted in an open discussion format and are concluded with the formation of specific task teams.

FRIDAY HAPPY HOUR

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

TO ENCOURAGE ACTIVE PARTICIPATION

CRITICAL THINKING AND INDEPENDENCE OF THOUGHT

GRADUATE TRAINING AND EDUCATION

INTERNATIONAL NEUROSCIENCE DOCTORAL PROGRAMME (INDP)

Programme Director: Alfonso Renart
Administrative Assistants: Alexandra Piedade and Teresa Carona

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. 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 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.

INDP Class of 2013

INDP STUDENTS

| 2013 Students |

Annelene Dahl
MSc Neuroscience
Norwegian University of Science and Technology, Norway

Antonia Groneberg
MSc Neuroscience
University of Heidelberg, Germany

Cristina Ferreira
Msc Oncology
Faculdade de Ciências da Universidade do Porto

Gabriela Fioreze
Bsc Biomedicine
Federal University of Health Sciences of Porto Alegre, Brazil

Jovin Jacobs
M.Sc. Cognitive and Computational Neuroscience
The University of Sheffield, United Kingdom

Lorenza Calcaterra
Msc Neurobiology
Bsc Neurobiology
University of Padua, Italy

António Dias
Msc in Evolutionary and Developmental Biology
Bsc Biology
Faculdade de Ciências da Universidade de Lisboa

Madalena Fonseca
M.A. Business and Management
Bsc Natural Sciences
Economics and Business Schools (ISEG)
Universidade Técnica de Lisboa

| 2012 Students |

Asma Motiwala
Temporal representations in brain
Laboratory of Christian Machens

Danbee Kim
Hunting Behaviour: One (Intelligent) System versus Another
Laboratory of Adam Kampff

Hedi Young
How feedback pathways shape feedforward information in mammalian neocortex
Laboratory of Leopoldo Petreanu, CNP

Marina Fridman
Characterization of projections from the lateral posterior nucleus of the thalamus to layer I of cortex
Laboratory of Leopoldo Peteranu

Mert Erginkaya
Characterization of Figure-Ground Discrimination Neurons in Drosophila
Laboratory of Eugenia Chiappe

Michael Pereira
Model Based Planning in Spatial Navigation
Laboratory of Christian Machens

Nuno Calaim
Learning to Represent and Store Relevant Events
Laboratory of Christian Machens

Nuno Loureiro
Operant EEG-based BMI: actively controlling external devices through brain activity
Laboratory of Rui Costa

Raphael Steinfeld
The contribution of Auditory Cortex to Working Memory
Laboratory of Alfonso Renart, CNP

Rita Felix
Linking activity in genetically defined neurons to visuomotor adaptation in zebrafish cerebellum
Laboratory of Michael Orger

| 2011 Students |

André Luzardo
A New Model for VOR Adaptation
Laboratory of C. Machens and M. Carey, CNP

Jacques Bourg
Information representation in stochastic recurrent neural networks
Laboratory of A. Renart, CNP

Jens Bierfeld
The effect of biogenic amines on motor pattern generating circuits in larval zebrafish
Laboratory of M. Orger, CNP

João Afonso
Who, when and how: Dissecting the amygdala-medial prefrontal cortex interplay during trace fear conditioning
Laboratory of A. Renart, CNP

Joaquim Jacob
Comparative neural analysis of singing central pattern generators in crickets
Laboratory of Berthold Hedwig, Cambridge University, UK

Ricardo Zacarias
Activity-dependent Regulation of Local Translation
Laboratory of I. Israely, CNP

Roberto Medina
Population Dynamics in the Mouse Auditory Cortex During Sound Localization
Laboratory of A. Renart, CNP

Silvana Araújo
Investigation into the Role of Orbitofrontal Cortex in the Mate Choice
Laboratory of S. Lima, CNP

Sofia Soares
Testing the role of dopamine in temporal discrimination in rats
Laboratory of J. Paton, CNP

Luis Moreira
Use of social information for mate choice in mice
Laboratory of S. Lima, CNP

| 2010 Students |

Bruno Miranda
The role of the entorhinal cortex in instrumental conditioning
Laboratory of Steven W. Kennerley, University College of London, UK

Ana Carolina de Sousa
Ant interaction networks: Task allocation in colonies in need of a new nest
Laboratory of N. Franks, University of Bristol, UK

Gustavo Mello
Influence of cortical input on time dependent striatal activity in rodents during interval timing
Laboratory of J. Paton, CNP

Gonçalo Lopes
Dissecting the Neural Basis of the Insect Path Integrator: A Comparative Approach
Laboratories of J. Paton & A. Kampff, CNP

Ivo Marcelo
Characterisation of memory trace networks in the lateral amygdala during consolidation
Laboratory of S. Kushner, Erasmus MC: University Medical Centre Rotterdam, The Netherlands

Tiago Marques
A novel paradigm for studying feature-based attention in the mouse primary visual cortex using a calcium imaging brain-machine interface
Laboratory of L. Petreanu, CNP

Simone Lackner
Understanding the function of Hypocretin/Orexin expressing neurons in neural circuits controlling visual-evoked locomotor behaviour in larval zebrafish
Laboratory of M. Orger, CNP

| 2009 Students |

Ali Ozgur Argunsah
Hippocampal synaptic plasticity induced by natural spike trains
Laboratory of I. Israely, CNP

Andreia Cruz
Lessons from others: a study of the mechanisms underlying social learning
Laboratory of M. Moita, CNP

Anna Hobbiss
Clustered plasticity as a model for micro-rewiring
Laboratory of I. Israely, CNP

Diogo Peixoto
Dynamics of neural activity in LIP during decision-making
Laboratory of W. Newsome, Stanford Univ., USA

Elizabeth Rickenbacher
Social modulation of fear extinction
Laboratory of M. Moita, CNP

David Raposo
The integration of evidence across modalities in the brain
Laboratory of A. Churchland, Cold Spring Harbour Laboratory, USA

Niccolò Bonacchi
Context dependent modulation of value
Laboratory of Z. Mainen, CNP

Pedro Garcia da Silva
Neuromodulatory enhancement of odour representations in the rodent olfactory bulb
Laboratory of F. Albeanu, Cold Spring Harbour Laboratory, USA

Raquel Abreu
Somatostatin-expressing neurons of the PreBötzinger Complex underlying Central Sleep Apnea
Laboratory of J. Feldman, UCLA, USA

Sevinç Mutlu
Cortical dynamics of excitation and inhibition during passive and active perception
Laboratory of Z. Mainen, CNP

Thiago Gouvêa
Motivational state modulation of decision making: reward expectation, phasic dopamine and choice accuracy
Laboratory of Z. Mainen, CNP

| 2008 Students |

André Mendonça
Attentional modulation of odour discrimination in rodents
Laboratory of Z. Mainen, CNP

Ana Rita Fonseca
Neural Mechanisms of Action Inhibition and Generation
Laboratory of Z. Mainen, CNP

Clara Ferreira
The role of octopaminergic neurons in appetitive olfactory learning and memory in Drosophila melanogaster
Laboratory of G. Miesenböck, University of Oxford, United Kingdom

Fernando Santos
Neuronal ensemble selection and competition during motor skill learning
Laboratory of R. Costa, CNP

João Marques
Understanding the Neural Mechanisms that Control Speed in Zebrafish Larvae
Laboratory of M. Orger, CNP

Ana Pereira
Sound discrimination in fear conditioning: an interaction between cortical and thalamic auditory structures
Laboratory of M. Moita, CNP

Ana Isabel Amaral
A Bayesian approach to audio□hallucinatory perception using oddball paradigm
Laboratory of D. Langers, Dep. of Otorhinolaryngology, University of Groningen, The Nederlands

Scott Rennie
The neural basis of social decision making, Rodents playing an iterated stag hunt game
Laboratory of M. Moita, CNP

Ana Mafalda Vicente
Neural Mechanisms Underlying The Shift Between Goal-Directed and Habitual Actions
Laboratory of R. Costa, CNP

Dennis Herrmann
Functional Architecture of the Neural System Controlling Female Reproductive Behaviour in Drosophila melanogaster
Laboratory of L. Vasconcelos, CNP

| 2007 Students |

Patrício Simões
The Influence of Phase Change on Learning and Memory in Desert Locusts
Laboratory of J. Niven, Department of Zoology, University of Cambridge, UK

Isabel Henriques
Hydrogen Sulphide Mechanisms in Acute Cerebral Ischemia
Laboratory of J. Ferro, Universidade Autónoma de Madrid, Spain

Rodrigo Abreu
Neuronal and endocrine mechanisms underlying cognitive appraisal and social modulation of behaviour in zebrafish (Danio rerio)
Laboratory of R. Oliveira, Instituto Superior de Psicologia Aplicada, Portugal

José Joaquim Fernandes
Neural correlates of hierarchical learning
Laboratory of M. Botvinick, Neuroscience Institute, Princeton University, USA

Íris Vilares
Uncertainty and decision making in the human brain: economics and motor control
Laboratory of K. Koerding, Rehabilitation Institute of Chicago, Northwestern University, USA

Patrícia Correia
Serotonin function in behaviour
Laboratory of Z. Mainen, CNP

Maria Inês Vicente
Neural mechanisms of uncertainty in brain function and behaviour
Laboratory of Z. Mainen, CNP

Pedro Ferreira
Circuit analysis of epigenetic changes during the consolidation of skills
Laboratory of R. Costa, CNP

Margarida Agrochão
Towards an ecological approach to vision: wireless recording from rat V1
Laboratory of M. Meister, Department of Molecular Cellular Biology, Harvard U. Uni. University, USA

Mariana Cardoso
Testing the Role of Cerebral Blood Flow on Neuronal Activity, in Mice Olfactory Glomeruli
Laboratory of A. Das, Department of Neuroscience, Columbia University, College of Physicians and Surgeons, USA

COURSES

2013

Techniques of experimental neuroscience I

16-20 Jan
Organisers: Adam Kampff (CNP), Michael Orger (CNP), Leopoldo Petreanu (CNP)
Teachers: Adam Kampff (CNP), Michael Orger (CNP), Leopoldo Petreanu (CNP)

Thinking about science & Exercises in group building

7-11 Jan
Coordinators: Alfonso Renart (CNP-FC) and Rita Venturini (CNP-FC)

History of Biological Concepts (IGC)

14-19 Jan
Coordinators: Thiago Carvalho (IGC)
Instructors: Elio Sucena (Instituto Gulbenkian de Ciência), Thiago Carvalho (Instituto Gulbenkian de Ciência), Lars Jansen (Instituto Gulbenkian de Ciência), Peter Bowler (University of Belfast, Ireland), Anthony Dean (University of Minnesota), Christen Mirth (Instituto Gulbenkian de Ciência), Jose Pereira Leal(Instituto Gulbenkian de Ciência), Jonathan Howard (IGC/ University of Cologne), Rui Oliveira (ISPA, Joe Paton (CNP-FC)

Techniques for Experimental Neuroscience

21-25 Jan
Coordinators: Adam Kampff (CNP-FC)

Fundamentals in Neuroscience I Cellular Physiology

28 Jan - 1 Feb
Coordinators: Joe Paton (CNP-FC), Marta Moita (CNP-FC)
Instructors: Bassam Atallah (CNP-FC), Cindy Poo (CNP-FC), Nicolas Morgenstern(CNP-FC), Pedro

Fundamentals in Neuroscience II Synaptic Physiology

4-9 Feb
Coordinators: Joe Paton (CNP-FC) and Marta Moita (CNP-FC)
Instructors: Alex Reyes (NYU/CNS, USA), Magor Lorincz (CNP-FC), Zachary Mainen (CNP-FC), Joe Paton (CNP-FC), Christian Machens (CNP-FC) and Susana Lima (CNP-FC)

Fundamentals in Neuroscience III Synaptic Plasticity

11-15 Feb
Coordinators: Joe Paton (CNP-FC) and Marta Moita (CNP-FC)
Instructors: Carlos Ribeiro (CNP-FC), Susana Lima (CNP-FC), Christian Machens (CNP-FC), Diasynou Fioravante (Harvard Medical School, USA), Marta Moita (CNP-FC), Megan Carey (CNP-FC) and Yazmin Cortes (CNP-FC)

Techniques for Experimental Neuroscience

18-22 Feb
Coordinators: Adam Kampff (CNP-FC)

Techniques for Experimental Neuroscience

25 Feb - 1 Mar
Coordinators: Adam Kampff (CNP-FC)

Fundamentals in Neuroscience Neural Development and Anatomy 1

4-8 Mar
Coordinators: Luisa Vasconcelos (CNP-FC), Carlos Ribeiro (CNP-FC)
Instructors: Chris Braun (Hunter College, NYC, US), Domingos Henrique (CNP and IMM) and Marta Moita (CNP-FC)

Evolution

11-15 Mar
Coordinators: Isabel Gordo (IGC)
Instructors: Brian Charlesworth (University of Edinburgh, UK) Thomas Bataillon (University of Aarhus, University of Montpellier, France), Lindi Wahl (University of Western Ontario, Canada and Instituto Gulbenkian de Ciência), Henrique Teotónio (Instituto Gulbenkian de Ciência) and José Alvarez Castro (Instituto Gulbenkian de Ciência)

Fundamentals in Neuroscience Neural Development and Anatomy 2

18-22 Mar
Coordinators: Luisa Vasconcelos (CNP-FC), Carlos Ribeiro (CNP-FC)
Instructors: Isabel Campos (CNP-FC), Luisa Vasconcelos (CNP-FC) and Carlos Ribeiro (CNP-FC)

Computational Neuroscience

1-5 Apr
Coordinators: Alfonso Renart (CNP-FC)
Instructors: Alfonso Renart (CNP-FC) and Albert Compte (IDIBAPS, Spain)

Sensation and Perception

8-12 Apr
Coordinators: Joe Paton (CNP-FC) and Leopoldo Petreanu (CNP-FC)
Instructors: Joe Paton (CNP-FC), Virginia Flanagin (LMU - University Hospital Munich-Grosshadern, Germany) , Alfonso Renart (CNP-FC), Luisa Vasconcelos (CNP-FC), Ekaterina Vinnik (CNP-FC) and Leopoldo Petreanu

Movement and Action

15-19 Apr
Coordinators: Rui Costa (CNP-FC) and Megan Carey (CNP-FC)
Instructors: Rui Costa (CNP-FC) and Megan Carey (CNP-FC)

Neuroethology

22-26 Apr
Coordinators: Michael Orger (CNP-FC), Eugenia Chiappe (CNP-FC)
Instructors: Michael Orger (CNP-FC), Eugenia Chiappe (CNP-FC) and Matthias Wittlinger (Universität Ulm, Institute of Neurobiology, Germany)

Cognition

29 Apr - 3 May
Coordinators: Marta Moita (CNP-FC), Zachary Mainen (CNP-FC)
Instructors: Marta Moita (CNP-FC), Zachary Mainen (CNP-FC)

Brain and Body Loops

6-10 May
Coordinators: Susana Lima (CNP-FC), and Carlos Ribeiro (CNP-FC)
Instructors: Giorgio Gilestro (Imperial College London, UK) Susana Lima (CNP-FC), and Carlos Ribeiro (CNP-FC)

Techniques for Experimental Neuroscience

13-17 May
Coordinators: Adam Kampff (CNP-FC)

Laboratory Rotations

20 May - onwards
CNP Laboratories

THESES

Lab of Eugenia Chiappe

Msc Thesis Awarded to Tomás Cruz in November, 2013
Development and test of a virtual reality system for tethered walking Drosophila
Instituto Superior Tecnico, Portugal

Lab of Rui Costa

PhD Thesis Awarded to Eduardo Dias Ferreira in February, 2013
The role of stress in cortico-basal ganglia loop processing and instrumental
University of Coimbra, Portugal

Lab of Inbal Israely

Msc Thesis Awarded to Inês Vaz da Cunha in September, 2013
Tracking dendritically synthesized proteins induced by synaptic activity
University of Coimbra, Portugal

Lab of Adam Kampff

Msc Thesis Awarded to Francisco Ferreira in December, 2013
Development of a human walking model Comprising springs and positive force feedback to generate stable gait
Instituto Superior Tecnico, Portugal

Lab of Susana Lima

Msc Thesis Awarded to António Dias in December, 2013
How early life experience shapes mate preference in female mice
Faculdade de Ciências da Universidade de Lisboa, Portugal

Lab of Zachary Mainen

MSc Thesis Awarded to Katherine Turco in September, 2013
Mapping the Serotonergic System: Topographical Organisation of Serotonergic Projections from the Dorsal Raphe Nucleus
University of Coimbra, Portugal

Lab of Leopoldo Petreanu

MSc Thesis Awarded to Rodrigo Dias in November, 2013
Development and characterization of a laser-scanning photo-stimulation setup for the optogenetic manipulation of behaviour in mice
Instituto Superior Tecnico, Portugal

Lab of Carlos Ribeiro

BSc Thesis Awarded to Gabriela Fioreze in August, 2013
Rastreio genetico para a identificação de receptors acoplados a proteinna G serotoninérgicos envolvidos na decisão nutricional em Drosophila Melanogaster
Federal University of Health Sciences of Porto Alegre (UFCSPA), Brasil

Lab of Domingos Henrique

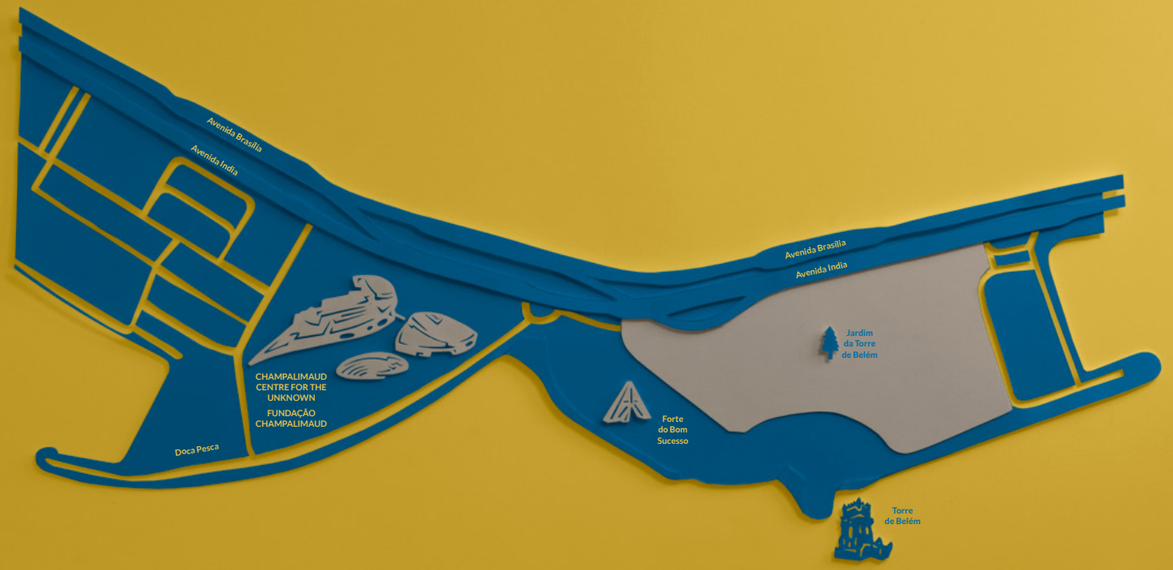
MSc Thesis Awarded to Williane Alves in November, 2013
Dissecting the Pluripotent state in Embryonic Stem Cells
Faculdade de Ciências da Universidade de Lisboa, Portugal

MSc Thesis Awarded to Pedro Barbacena in December, 2013
Unravelling the regulation of Dll4 expression and its function during embryonic neurogenesis
Faculdade de Ciências da Universidade de Lisboa, Portugal

| 2007 INDP Students |

PhD Thesis Awarded to José Ribas Fernandes in Novemeber, 2013
Hierarchical reinforcement learning in behaviour and the brain
Lab of Matthew Botvinick. Princeton University, USA

PhD Thesis Awarded to Iris Vilares in December, 2013
Uncertainty and decision-making in the human brain
Lab of Konrad Kording. Northwestern University, USA



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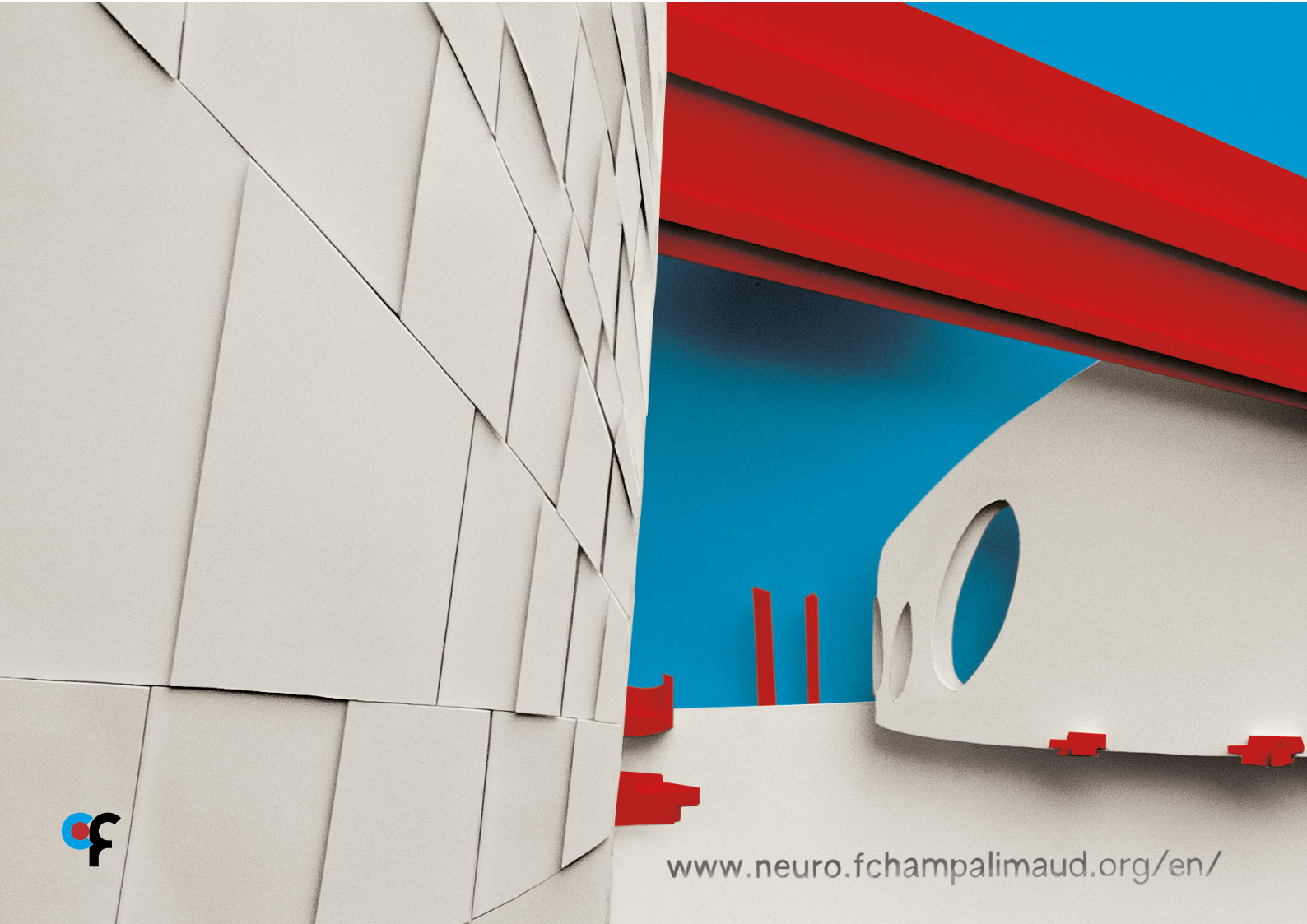
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