champalimaud research

CR

2017

Annual Report

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Revising
The CR Community with
special thanks to
Dennis Goldschmidt
and Teresa Fernandes

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CR

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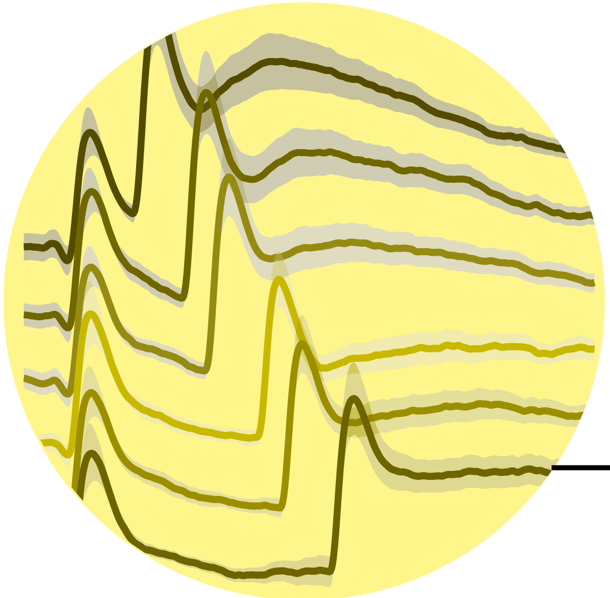
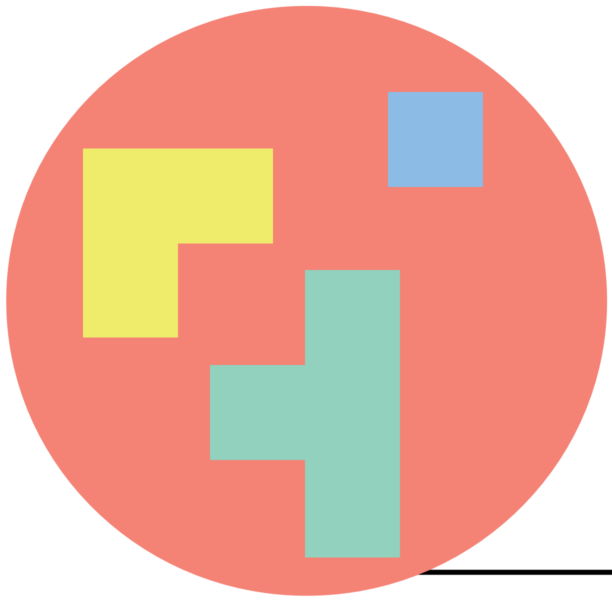
Annual Report

Champalimaud Foundation





CELEBRATING THE FIRST TEN YEARS OF CHAMPALIMAUD RESEARCH

A

B

C

D

A - The first CR annual retreat
Azaruja, 2008.

B- Emergence
Audience members participating in the outreach event Emergence, organised by the student initiative Ar | Respire Connosco in 2011.

C - Champalimaud Symposium
Participants at the 2017 Symposium; the inaugural conference to launch the Biology of Systems and Metastasis Research Programme.

D - Ten years celebration. CR members gathering for the celebration and exhibit opening at the Champalimaud Centre for the Unknown, 2017.

"IT ALL BEGAN AT AN AUSPICIOUS MEETING AT THE YORK HOUSE, A HOTEL IN LISBON CITY CENTER, IN THE SUMMER OF 2006"

The research effort of the Champalimaud Foundation began one decade ago in collaboration with the Instituto Gulbenkian de Ciência (IGC). The conception no doubt has a longer history, but for several of us, namely Marta Moita, Rui Costa and myself, it all began at an auspicious meeting at the York House, a hotel in Lisbon city center, in the summer of 2006, where the aims of an ambitious international research programme were articulated. Our mission was nothing short of understanding the biological bases of behaviour.

Shortly thereafter, in 2007, I was recruited from Cold Spring Harbor Laboratory, New York, to help found the Champalimaud Neuroscience Programme (CNP) and to direct the Programma Gulbenkian-Champalimaud de Neurociências (PGCN) doctoral programme, which was soon re-christened the International Neurosciences Doctoral Programme (INDP). I joined Marta Moita, whose lab was already in place at the IGC. In 2008, Rui Costa, Inbal Israely, Susana Lima, Joe Paton, and Carlos Ribeiro were selected to join us and their labs began to be installed that year.

Within the first year of the CNP, this close-knitted group of young principal investigators defined the vision of the new research programme. The main aspiration was stated - to help scientists to reach their full creative potential and to promote collective achievements beyond those reachable by individual scientists or laboratory groups. Toward this end, we defined a set of concrete aims targeted to create a unique scientific culture that has been the driving force of the research programme ever since.

Fully integrated within the IGC in these years, the CNP was nurtured under the auspices of the broad-based biological research of the IGC under the broad-minded scientific guidance of António Coutinho, the director of the IGC at the time. Soon we were awarded our first two European Research Council (ERC) grants, the most prestigious and competitive in Europe.

Our second phase began in 2010 as the Champalimaud Centre for the Unknown (CCU) was inaugurated, and we selected the second wave of investigators, who would be installed in the new Centre. In January 2011, we began to move from the IGC to the state-of-the-art facilities of the CCU together with the new labs of Megan Carey, Adam Kampff, Alfonso Renart and Michael Orger. These groups were followed shortly by Eugenia Chiappe, Christian Machens, Leopoldo Petreanu and Luisa Vasconcelos. In short order we had reached 15 investigators and well over 100 researchers, working in species from mice to zebrafish to flies and even humans.

Many firsts occurred during these days. We invited the larger community to join us in the inaugural Champalimaud Symposium in autumn of 2011, we launched our first scientific and technical platforms and the first science outreach event of the Ar series, "Engineering the Mind", took place at the CCU auditorium. In 2012, the first study conducted entirely in-house was published and in 2013 the first student from the INDP graduated.

In 2014 we added two more groups in neuroscience, Gonzalo de Polavieja and Noam Shemesh, along with a major new platform for ultra-high resolution magnetic resonance imaging, while Adam Kampff's lab departed for a new post at University College London. We were also selected as a site for the CAJAL Summer School initiative by the Federation for European Neuroscience and International Brain Organisation. By the end of 2014, we counted five ERC grants and 148 publications, nearly half of those published in journals that have an impact factor greater than 10.

The third phase of the programme also began in 2014, with the creation of the Biology of Systems and Metastasis (BSM) programme, whose goal is to understand the fundamental biology of cancer, and its integration with the CNP under Champalimaud Research (CR). With this, Rui Costa, who had been serving as Deputy Director, was named as Co-Director of the newly formed CR. The first BSM groups were selected in 2015 and began to join the CR in 2016, bringing the labs of Bruno Costa-Silva, Eduardo Moreno, Christa Rhiner and Henrique Veiga-Fernandes. One year later, Celso Matos joined the CR Direction Team, representing the important arm of clinical research.

2017 was our most productive year so far, with four new ERC grants won, joining a list of nine ERC grants awarded to CR Principal Investigators. Furthermore, 53 new research articles were published, bringing the number of research articles by CR researchers to a total of 254. In 2017, the first edition of the Champalimaud Symposium that was dedicated to cancer research was held. This symposium was a very special event as it served as the inaugural conference to launch the BSM Programme.

Over the span of this past decade, we have built a thriving research programme, now counting more than 300 members, gathered from across the world. We have endeavoured to create an atmosphere that nurtures individual talents, while promoting collaboration and a sense of community. With the tools that we have established, we believe that CR is well poised to continue on its path to finding answers to some of biology's most important questions.

Zachary Mainen, on behalf of the CR Direction Team.

THE FOUNDATION

THROUGH SCIENTIFIC BREAKTHROUGHS AND CLINICAL DEVELOPMENTS, THE FOUNDATION IS THERE TO HELP THOSE WHO NEED IT MOST.

CHAMPALIMAUD FOUNDATION - BOARD OF DIRECTORS

Leonor Beleza,
President

João Silveira Botelho,
Vice President

António Horta-Osório,
Member of the Board

The Champalimaud Foundation exists as the legacy of Portuguese entrepreneur and industrialist, the late António de Sommer Champalimaud. In accordance with the will of António Champalimaud, Leonor Beleza is the President of the Foundation, which was formally created in 2005 under its full title of the Anna de Sommer Champalimaud and Dr. Carlos Montez Champalimaud Foundation, in honour of the benefactor's parents.

The Foundation gives full backing to its researchers who work on the frontline of science and biomedicine. The Foundation's research scientists and doctors use their creativity, experience and talents to find new and innovative ways to approach the many questions of modern neuroscience and oncology.

A

B

C

A - Celebrating ten years of research at Champalimaud

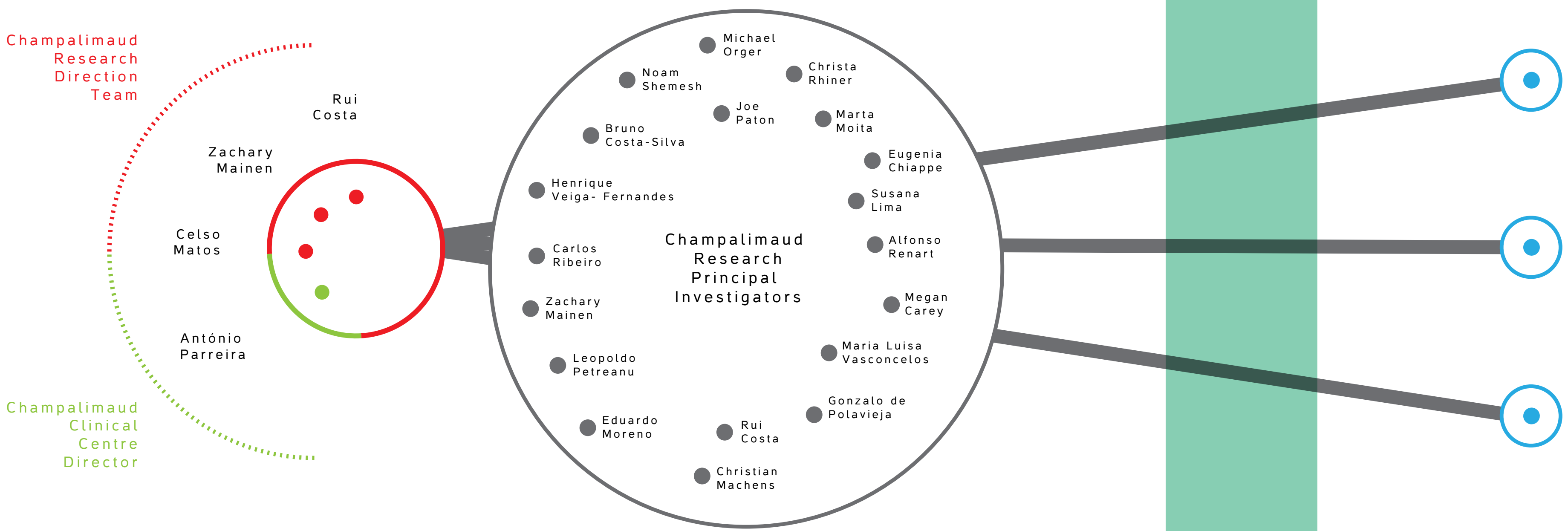
Leonor Beleza addressing the CR community at the celebration. Next to her are Zachary Mainen, Marta Moita, Rui Costa and João Silveira Botelho.

B - Champalimaud Centre for the Unknown

Students sketching some of the public areas of the Centre.

C - Tall Ships Race

Spectators watching boats sailing in front of the Centre during the Tall Ships Race Lisboa.



CHAMPALIMAUD RESEARCH SUPPORT UNITS

- EDUCATION & COURSES
- EVENTS
- HR & FELLOWS
- LAB ADMINISTRATION
- OFFICE FOR SPONSORED PROGRAMMES
- OPERATIONS
- SCIENCE COMMUNICATION

INTERNATIONAL NEUROSCIENCE DOCTORAL PROGRAMME (INDP)

- DIRECTION
- COORDINATION
- TEACHING LAB

SCIENTIFIC & TECHNOLOGICAL PLATFORMS

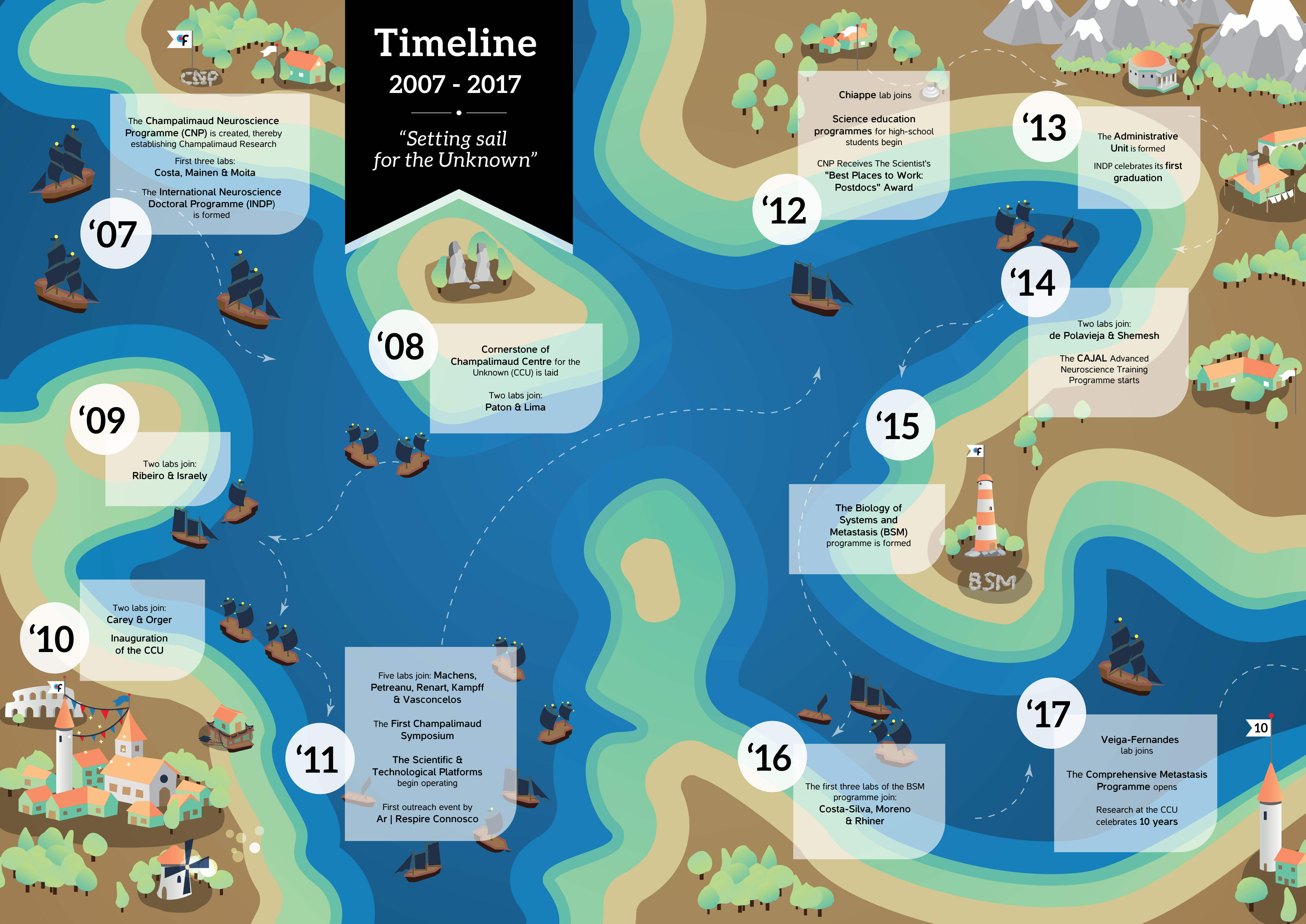
- FISH PLATFORM
- FLOW CYTOMETRY
- FLY PLATFORM
- GLASSWASH & MEDIA PREPARATION
- HISTOPATHOLOGY
- MOLECULAR BIOLOGY
- OPTICAL IMAGING & MICROSCOPY
- RODENT FACILITY
- SCIENTIFIC HARDWARE
- SCIENTIFIC SOFTWARE

SCIENTIFIC ADVISORY BOARD

The Scientific Advisory Board (SAB) of CR is composed of internationally recognised scientists, who meet annually to review the progress of CR researchers and programmes. It consists of regular members and additional external members who join on a yearly basis.

2017 SAB MEMBERS:

- Caetano Reis e Sousa (The Francis Crick Institute, London, UK)
- Anthony Movshon (New York University, USA)
- Martin Raff (University College London, UK)
- Robert Horvitz (Massachusetts Institute of Technology, USA)

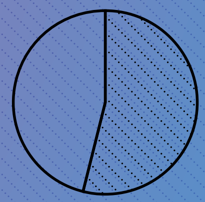

Timeline
2007 - 2017
"Setting sail for the Unknown"
CNP
'07
The Champalimaud Neuroscience Programme (CNP) is created, thereby establishing Champalimaud Research
First three labs: Costa, Mainen & Moita
The International Neuroscience Doctoral Programme (INDP) is formed
'08
Cornerstone of Champalimaud Centre for the Unknown (CCU) is laid
Two labs join: Paton & Lima
'09
Two labs join: Ribeiro & Israely
'10
Two labs join: Carey & Orger
Inauguration of the CCU
'11
Five labs join: Machens, Petreanu, Renart, Kampff & Vasconcelos
The First Champalimaud Symposium
The Scientific & Technological Platforms begin operating
First outreach event by Ar | Respire Connosco
'12
Chiappe lab joins
Science education programmes for high-school students begin
CNP Receives The Scientist's "Best Places to Work: Postdocs" Award
'13
The Administrative Unit is formed
INDP celebrates its first graduation
'14
Two labs join: de Polavieja & Shemesh
The CAJAL Advanced Neuroscience Training Programme starts
'15
The Biology of Systems and Metastasis (BSM) programme is formed
BSM
'16
The first three labs of the BSM programme join: Costa-Silva, Moreno & Rhiner
'17
Veiga-Fernandes lab joins
The Comprehensive Metastasis Programme opens
Research at the CCU celebrates 10 years
10

Growth & Diversity

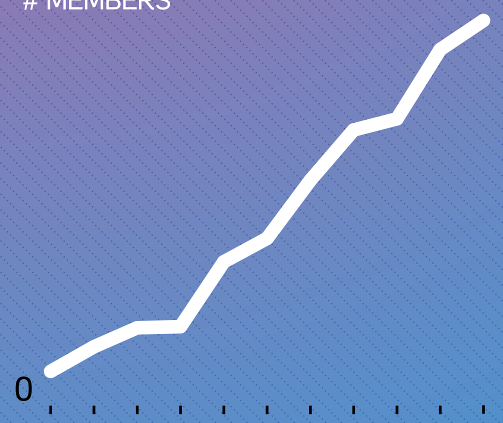
331

CHAMPALIMAUD RESEARCH MEMBERS

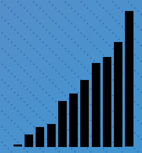
46% Male



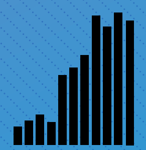
54% Female



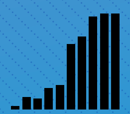
Principal investigators (6%)



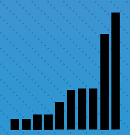
Postdoctoral researchers (27%)



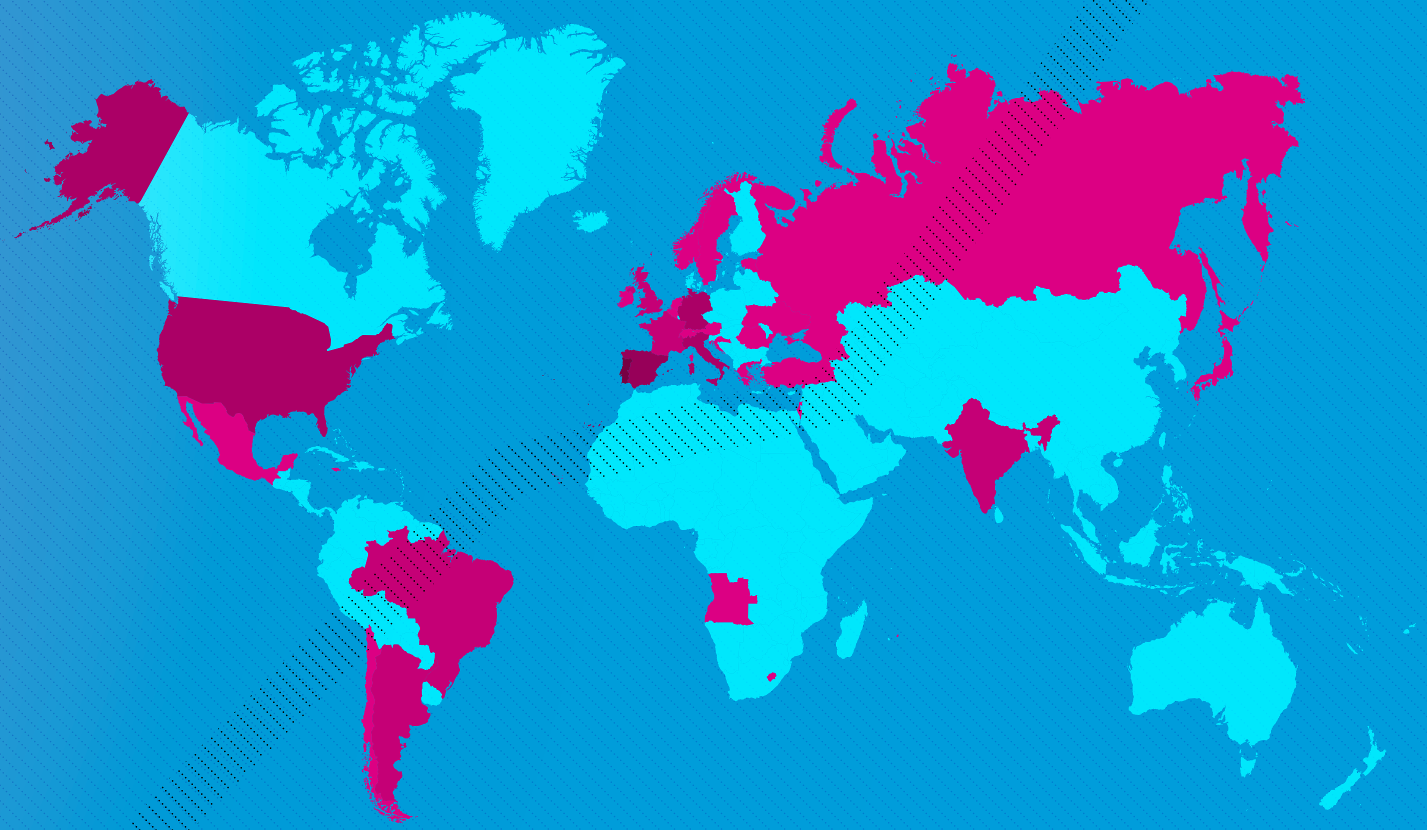
PhD students (25%)



Research technicians (19%)



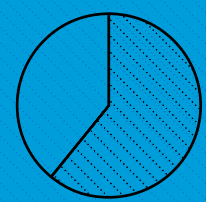
Support (23%)



34

COUNTRIES OF ORIGIN

39% Non-Portuguese

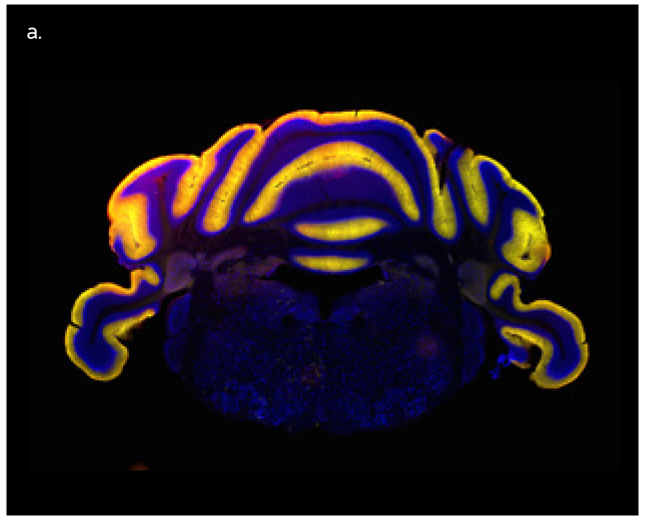


61% Portuguese

2	ANGOLA	2	JAPAN
3	ARGENTINA	1	LESOTHO
1	AUSTRIA	1	MAURITIUS
1	BELGIUM	1	MEXICO
7	BRAZIL	2	NORWAY
4	CAPE VERDE	1	POLAND
1	CHILE	203	PORTUGAL
1	CROATIA	1	ROMANIA
1	ESTONIA	2	RUSSIA
8	FRANCE	17	SPAIN
15	GERMANY	1	SWEDEN
1	GREECE	2	SWITZERLAND
6	INDIA	2	THE NETHERLANDS
1	IRELAND	3	TURKEY
4	ISRAEL	10	UNITED KINGDOM
11	ITALY	1	UKRAINE
1	JAMAICA	13	UNITED STATES OF AMERICA

POSTCARDS FROM THE UNKNOWN

a.



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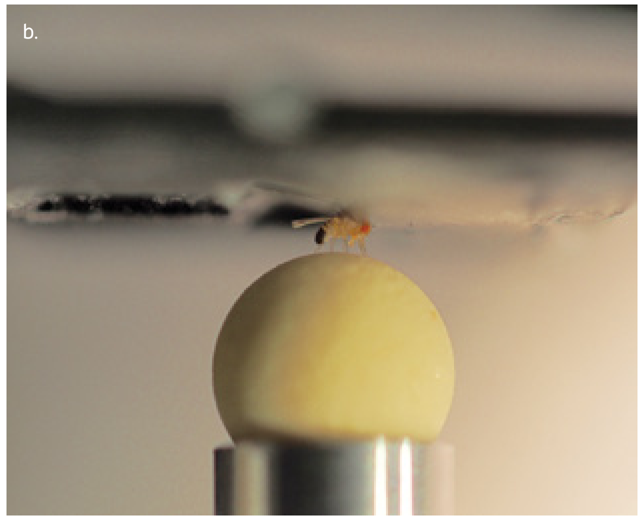

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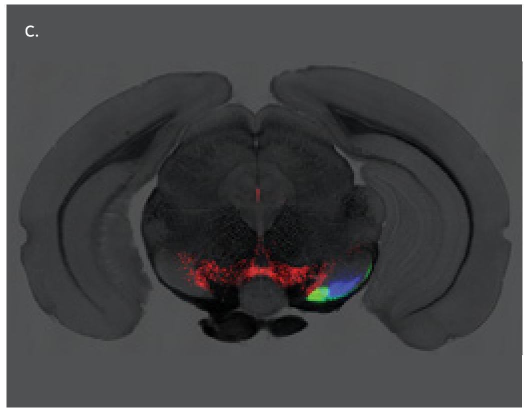

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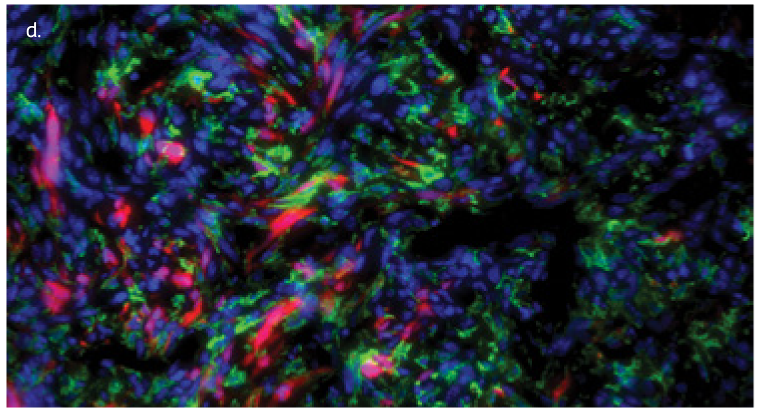

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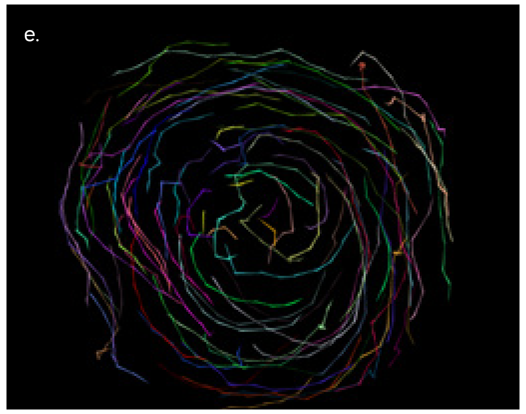

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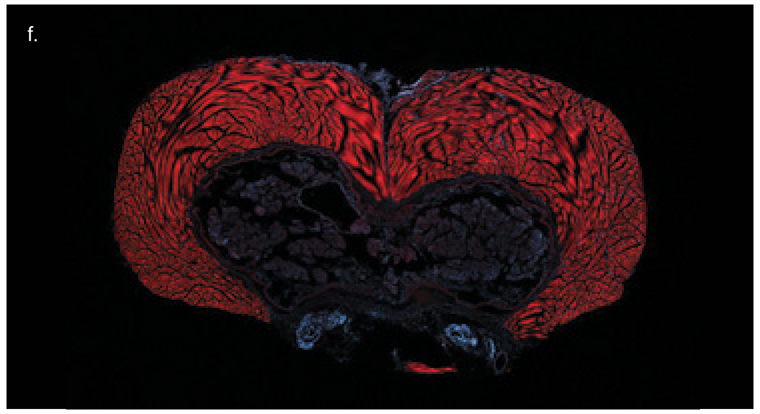
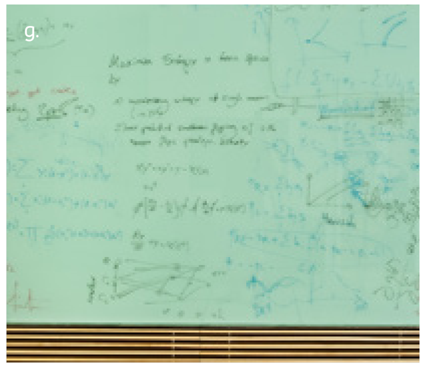
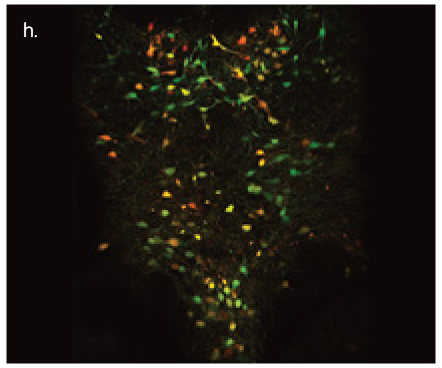


g.



h.



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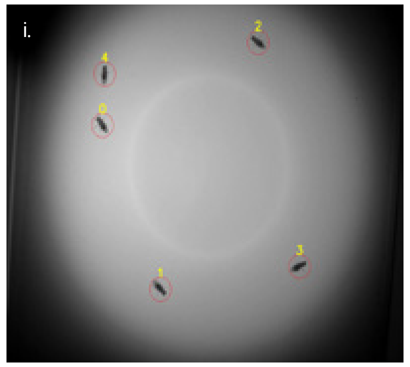

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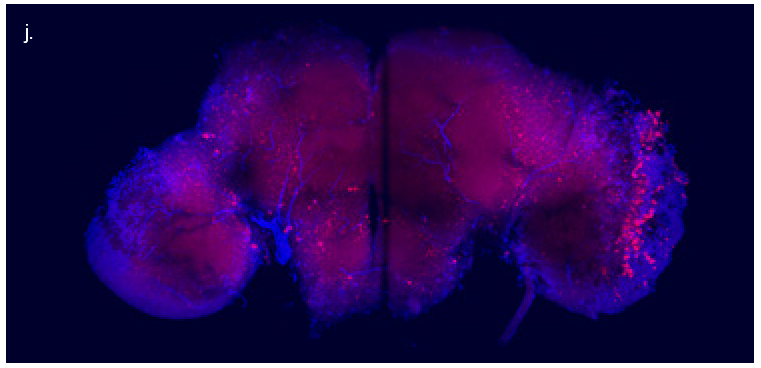

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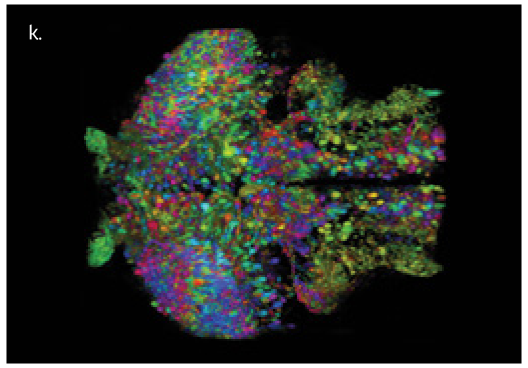

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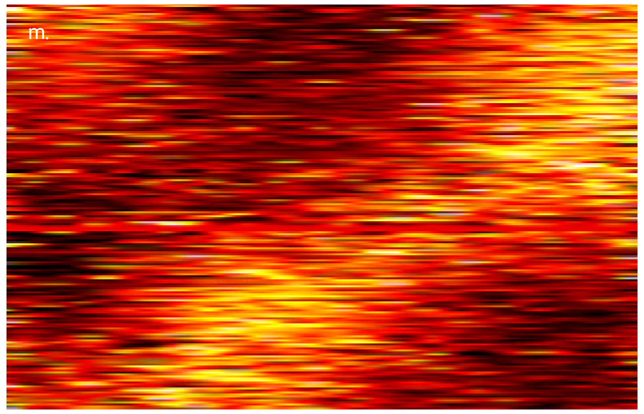

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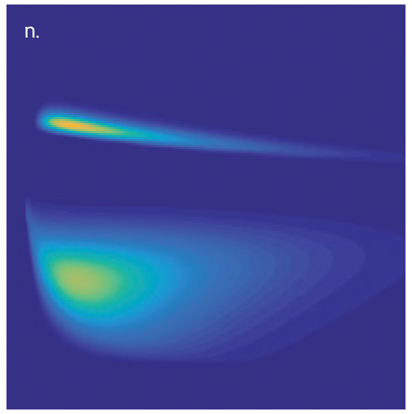

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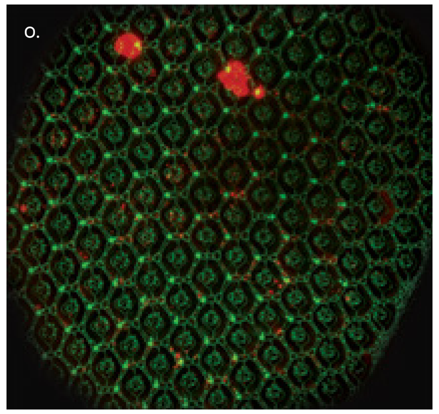

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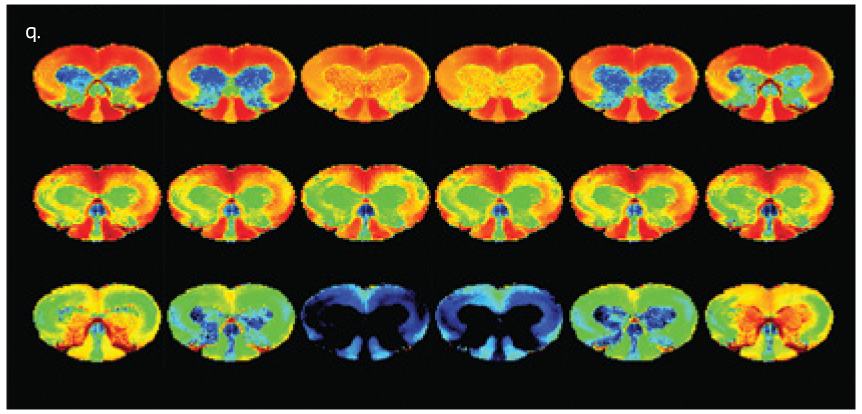
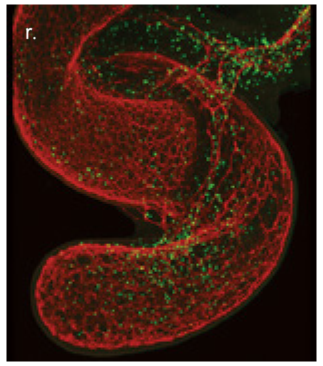
q.



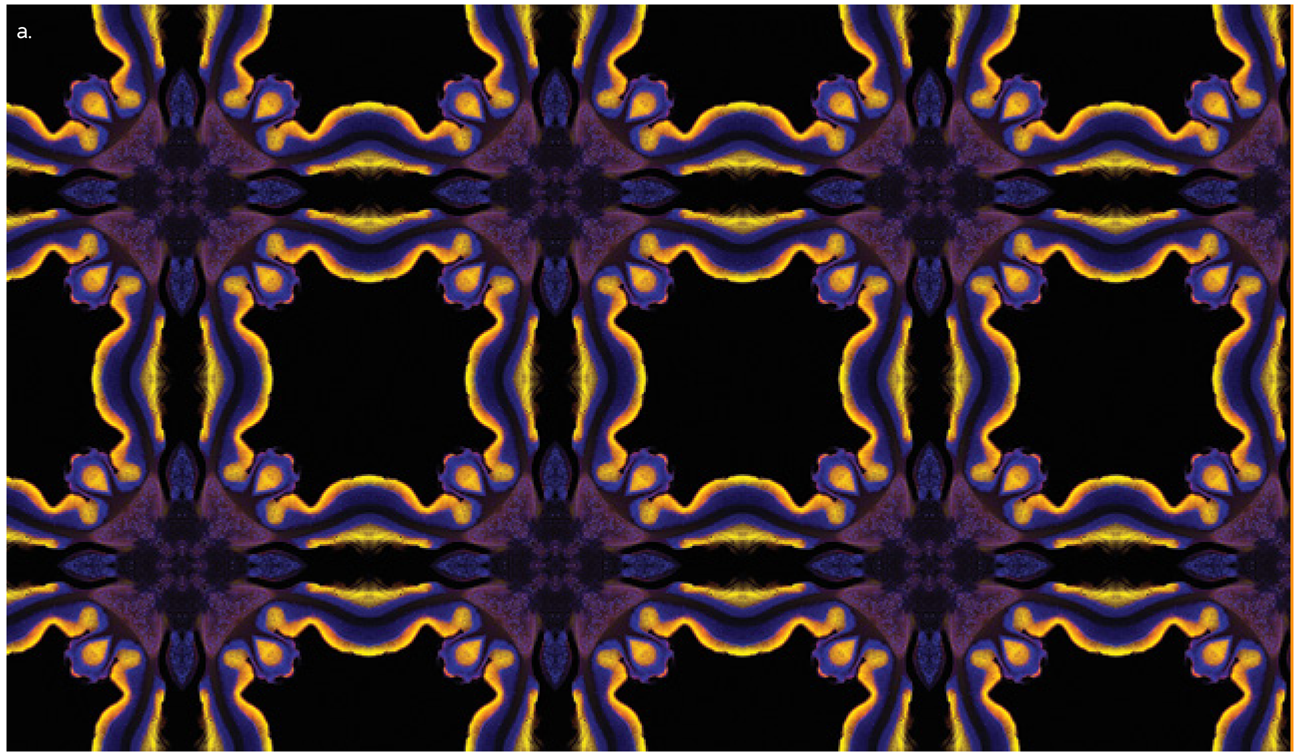
Celebrating ten years of Champalimaud Research

This series of images was featured in a public photo exhibit that was created to commemorate the first ten years of Champalimaud Research.

r.



s.



Principal Investigator
MEGAN CAREY

NEURAL CIRCUITS AND BEHAVIOUR LAB

It's obvious when we think about lead athletes, like gymnasts, that people are capable of remarkable feats of coordination. But in fact, moving different parts of the body relative to each other in a coordinated manner while keeping our bodies balanced and remaining stable is a complex problem that the brain solves all the time. How does the brain control our movements and what happens when the underlying neural circuits malfunction?

Scientific Approach

The Neural Circuits and Behaviour lab studies the cerebellum, a brain area that is critical for coordinated motor control and motor learning. The well-described cerebellar circuit is conserved across species, which enables the researchers to study it in mice, a powerful animal model that offers an array of genetic tools. Using these tools, the researchers are able to measure and manipulate activity in specific populations of neurons in the cerebellum. In some cases, these manipulations mirror neural conditions that exist in humans who suffer damage to the cerebellum through illness or injury. Among the recent advances in the lab was the development of LocoMouse, an open-source tool that allows researchers to observe the fine details of movement with near-millisecond and millimeter resolution. The team developed this tool as the first step in their large-scale project to reveal the neural circuits that generate coordinated walking, for which the lab has received significant support from the European Research Council.

MAIN INTERESTS:
How the brain generates and controls coordinated movement

METHODS:
Quantitative behavioural analysis, Electrophysiology and Optogenetics

MODEL /AREA OF FOCUS:
Rodents / Cerebellum

NEURAL CIRCUITS AND BEHAVIOUR LAB

LAB MEMBERS

POSTDOCTORAL RESEARCHERS

1. Ana Machado
2. Dennis Eckmeier
3. Hugo Marques
4. Dominique Pritchett
5. João Fayad

PHD STUDENTS

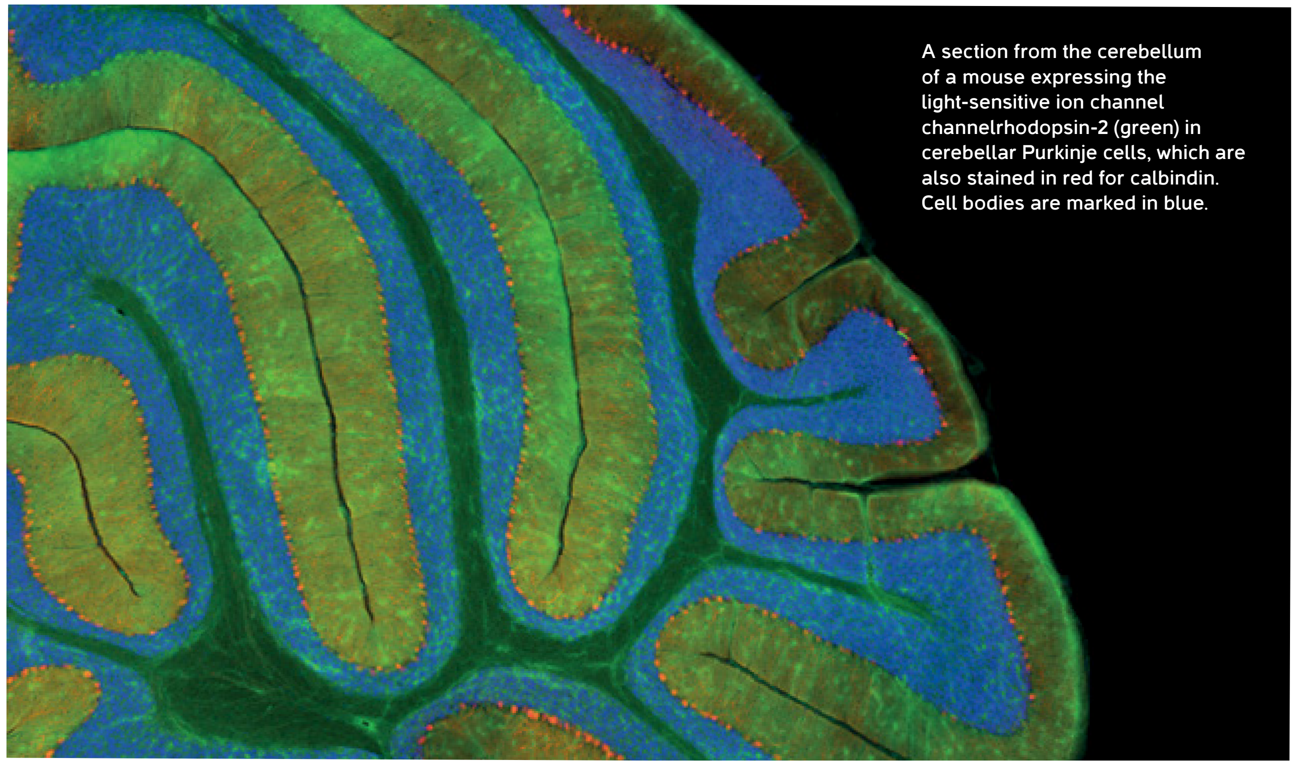
6. Ana Gonçalves
7. Jovin Jacobs
8. Tatiana Silva
9. Dana Darmohray
10. Catarina Albergaria
11. Rita Félix (Co-supervised with Michael Orger)

MASTER'S STUDENTS

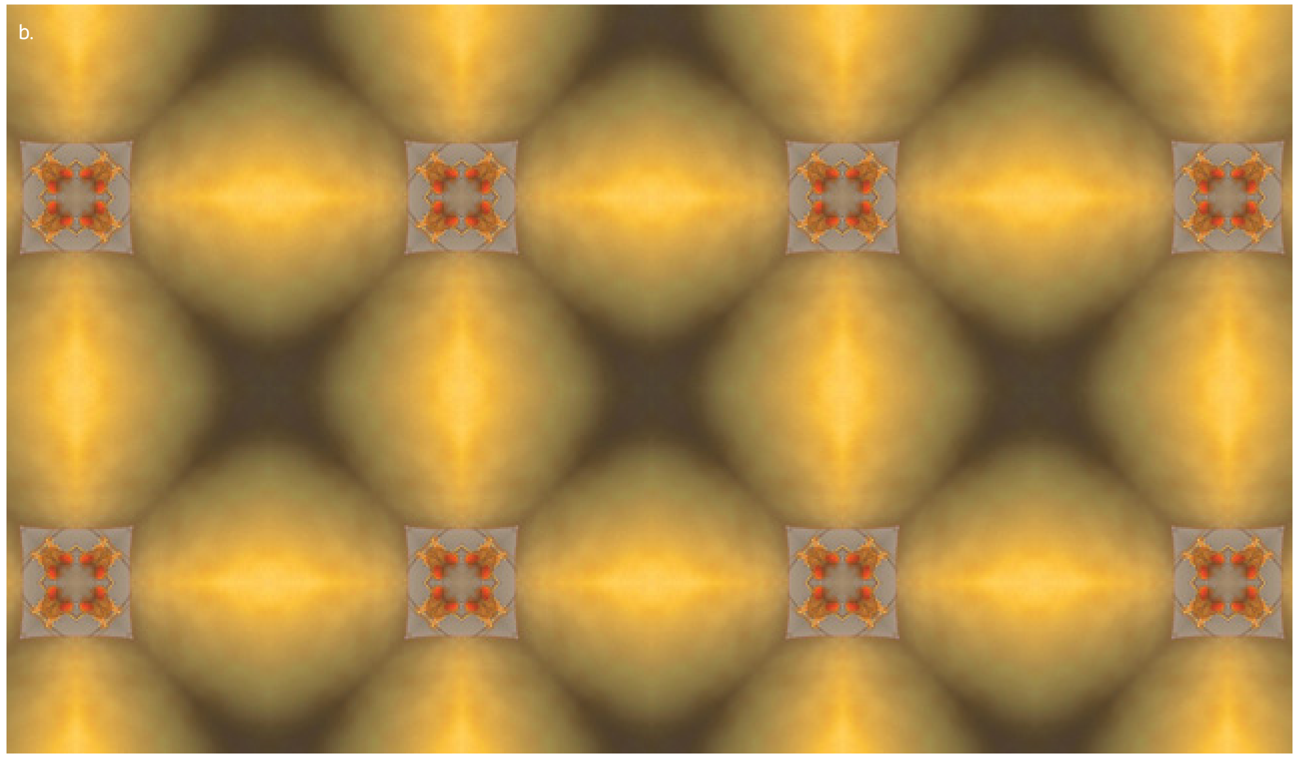
12. Hugo Bettencourt
13. Marta Maciel

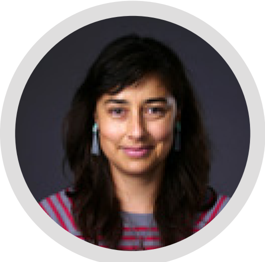
RESEARCH TECHNICIANS

14. Diogo Duarte
15. Tracy Pritchett



A section from the cerebellum of a mouse expressing the light-sensitive ion channel channelrhodopsin-2 (green) in cerebellar Purkinje cells, which are also stained in red for calbindin. Cell bodies are marked in blue.





Principal Investigator
EUGENIA CHIAPPE

SENSORIMOTOR INTEGRATION LAB

Think about how difficult moving around might be if you didn't have a sense of your body's configuration (whether you are standing, sitting, or lying), and your body's speed. In fact, to ensure the success of the most trivial, or the most elaborate action, the brain of all animals, from insects to humans, has to simultaneously process and combine rapidly changing sensory information, while monitoring the position of all body parts, their speed of movement and the body's posture. The Sensorimotor Integration lab is interested in understanding how the brain orchestrates all these signals to form an internal representation of self-movement, and how this representation controls locomotion.

Scientific Approach

The research strategy of the lab focuses on connecting neural activity dynamics to the locomotive behaviour of the fruitfly, *Drosophila melanogaster*. The researchers employ multiple methods to record and reversibly perturb neural activity in behaving flies, to analyse the structure of interconnected neurons, to quantify different aspects of the fly's locomotive behaviour, and to model functional networks. This multidisciplinary approach, together with the ever-expanding genetic toolkit of the fruitfly, allows the team to find mechanistic explanations for how multi-sensory and sensorimotor integration processes in the brain are used to guide adaptive behaviour.

In 2017, Eugenia Chiappe, the principal investigator of the team, was awarded an ERC Starting Grant to support her research towards understanding the fundamental principles for the function and organisation of neural circuits involved in estimating an animal's own movement, especially in the context of visually guided locomotion. Many basic functions of our brain, from motor control, to more cognitive operations such as navigation, critically depend on self-movement estimation. With the support of this funding, the team will investigate which circuits are involved in this representation, and what computations these circuits perform. In addition, they will work on identifying the activity dynamics and mechanisms by which these computations are generated.

MAIN INTERESTS:
The computational principles that govern motor and sensory coordination

METHODS:
Electrophysiology, Optical tools, Behaviour, Virtual reality, Whiteboard and literature

MODEL /AREA OF FOCUS:
Fruit flies / Sensory, Motor and Premotor brain areas

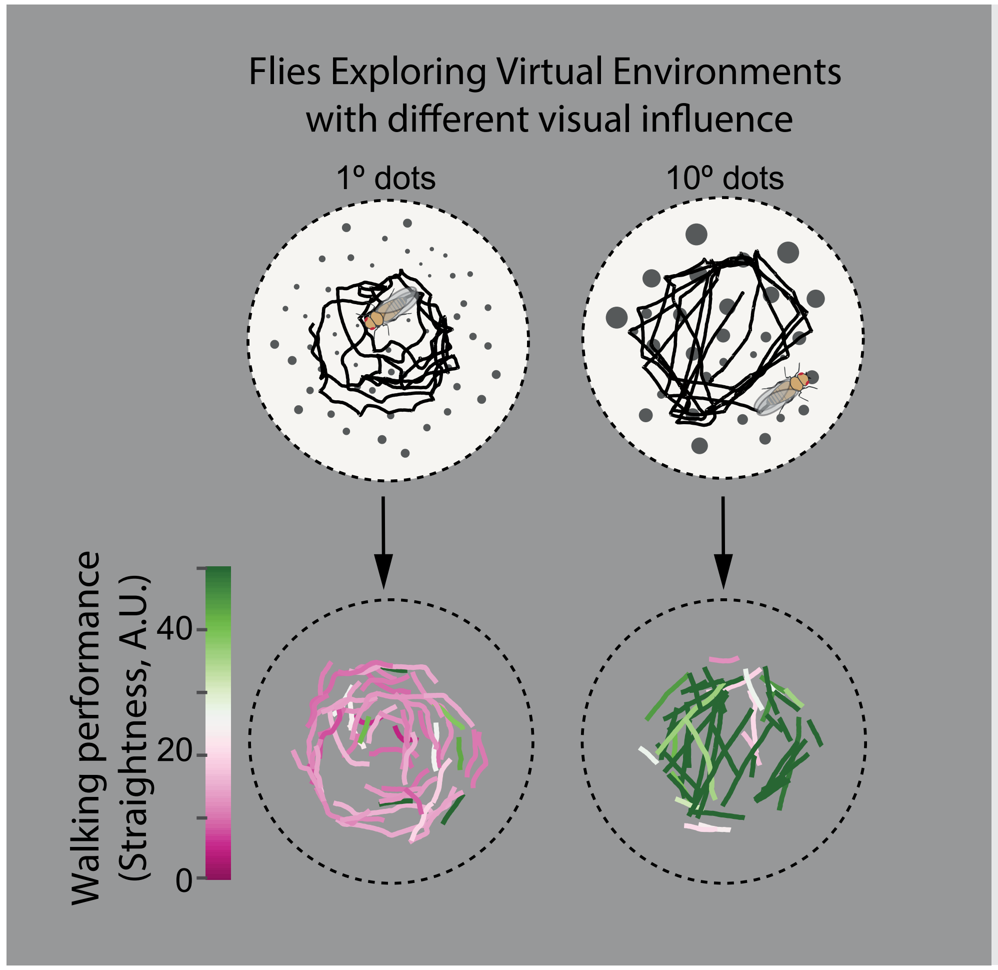
SENSORIMOTOR INTEGRATION LAB

LAB MEMBERS

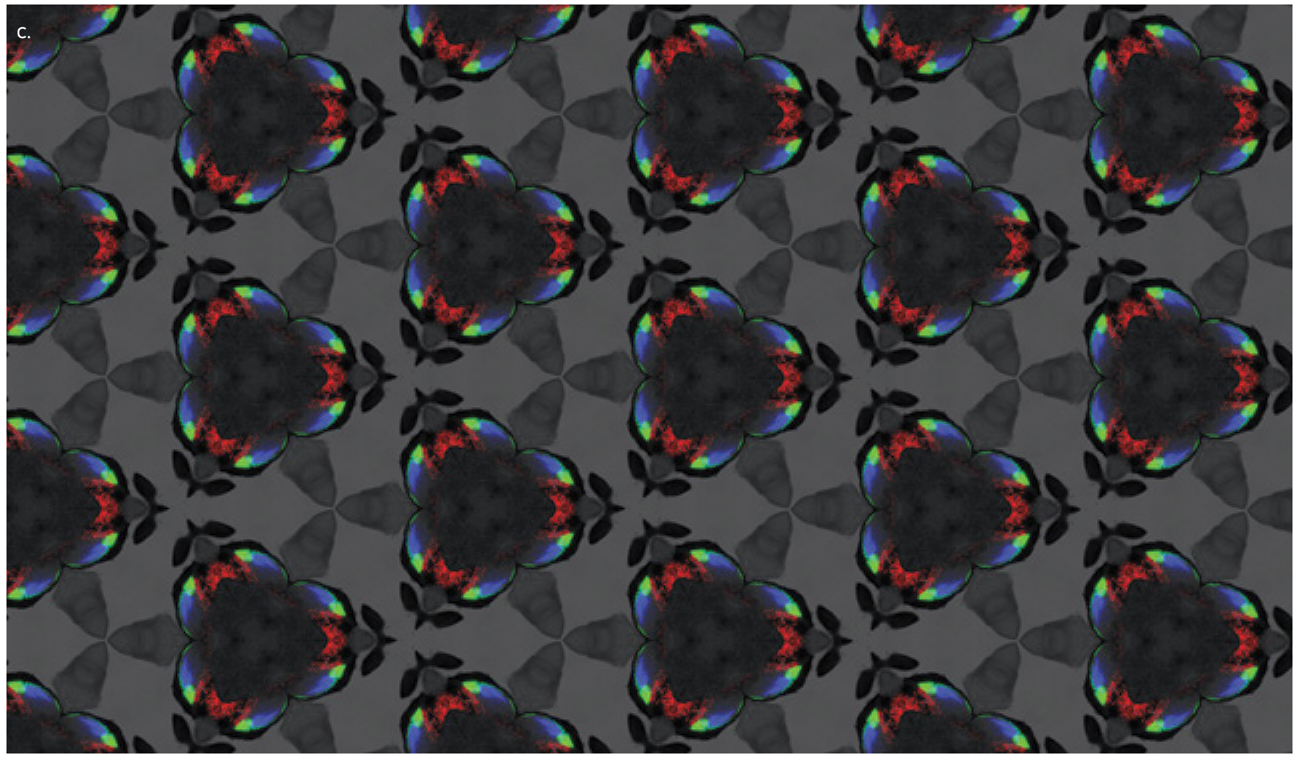
POSTDOCTORAL RESEARCHERS
1. Nélia Varela
2. Terufumi Fujiwara

PHD STUDENTS
3. Mert Erginkaya
4. Tomás Cruz
5. Nuno Rito

RESEARCH TECHNICIANS
6. André Marques
7. Saliha Ece Sönmez



Flies exploring virtual environments with different visual influence.
Using a combination of virtual reality techniques, and quantitative analytical tools the lab studies how vision controls locomotion performance. Top row, flies walking in a virtual environment with different visual influence (dots that are detected or not by the fly due to her visual spatial resolution). Black traces depict travelled paths. Bottom, performance of locomotion measured as the straightness quality of the fly's walking paths. Detecting the visual structure of the environment improves walking performance.



Principal Investigator

RUI COSTA

NEUROBIOLOGY OF ACTION LAB

Our daily lives can be viewed as a series of actions. Some of them, like driving home, are well-rehearsed and habitual, while others, such as learning how to play a new sport, require goal-directed attention. We know intuitively that these different types of actions require different mental resources. For instance, while you could easily sing along with the radio while driving home, you probably wouldn't manage it quite as well on your first day on the tennis court. This fact may seem trivial, but it raises many different questions as to how are these differences reflected on the level of the brain: Are habitual and goal-directed actions controlled by the same or different neural processes? How does the brain learn to perform new actions? What happens if the neural circuits that underlie action initiation or termination malfunction?

Scientific Approach

To find the answers to these questions, the Neurobiology of Action lab uses a cross-level approach, from molecules to neural circuits. Specifically, the lab focuses on the interaction of the Basal Ganglia, a brain region known to be involved in motor learning and in the control of movement, with areas in the cortex that are important in motor planning and decision-making. These brain areas are also affected in neural disorders such as Parkinson's Disease, Huntington's Disease and Obsessive Compulsive Disorder. Work from the lab has generated various findings in the field, including the description of a process called "chunking" in the basal ganglia in which single motor elements are joined, or "chunked" together to create a single entity. Through this process, for example, the neural representations of single syllables may become representations of entire words. In addition, the team has identified that mastering challenging motor tasks depends on the brain's ability to select the most important movement elements. Finally, most recently, the lab has produced groundbreaking observations challenging some of the previously held perceptions regarding the role of subcircuits in the basal ganglia.

MAIN INTERESTS:
How the brain generates and selects actions

METHODS:
Optogenetics, Electrophysiology and Behaviour

MODEL /AREA OF FOCUS:
Rodents, Humans / Basal Ganglia, Orbitofrontal Cortex

NEUROBIOLOGY OF ACTION LAB

LAB MEMBERS

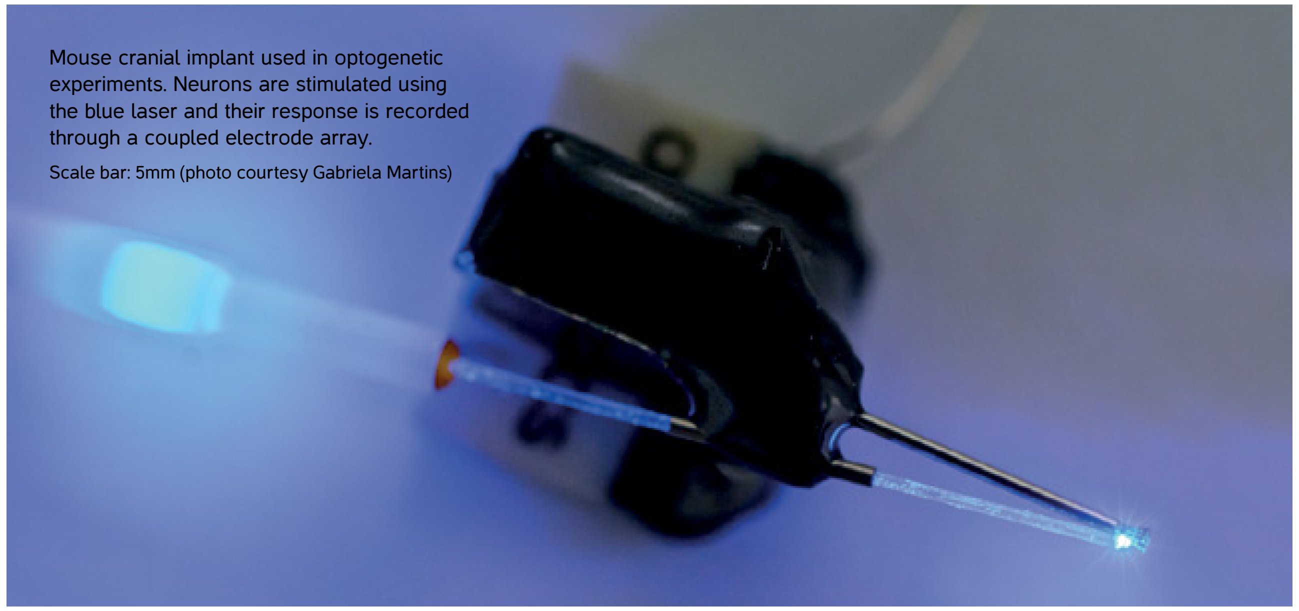
POSTDOCTORAL RESEARCHERS
1. Aaron Koralek
2. Ana Cruz
3. Ana Fernandes
4. Andreas Klaus
5. Catherine French
6. Cristina Afonso
7. Cristina Álcacer
8. Daniela Pereira
9. Nicolas Morgenstern
10. Rodrigo Oliveira
11. Sevinç Mutlu
12. Thomas Akam
13. Vitor Paixão

PHD STUDENTS
14. Ana Castro
15. Inês Vaz da Cunha
16. Ivo Marcelo
17. Joaquim Alves da Silva
18. Marcelo Sousa
19. Michael Pereira (Co-supervision with Christian Machens)
20. Nuno Loureiro
21. Patricia Rachinas Lopes

RESEARCH TECHNICIANS
22. Ana Rita Afonso
23. Sandra Gomes
24. Ana Vaz
25. Catarina Carvalho
26. João de Araújo

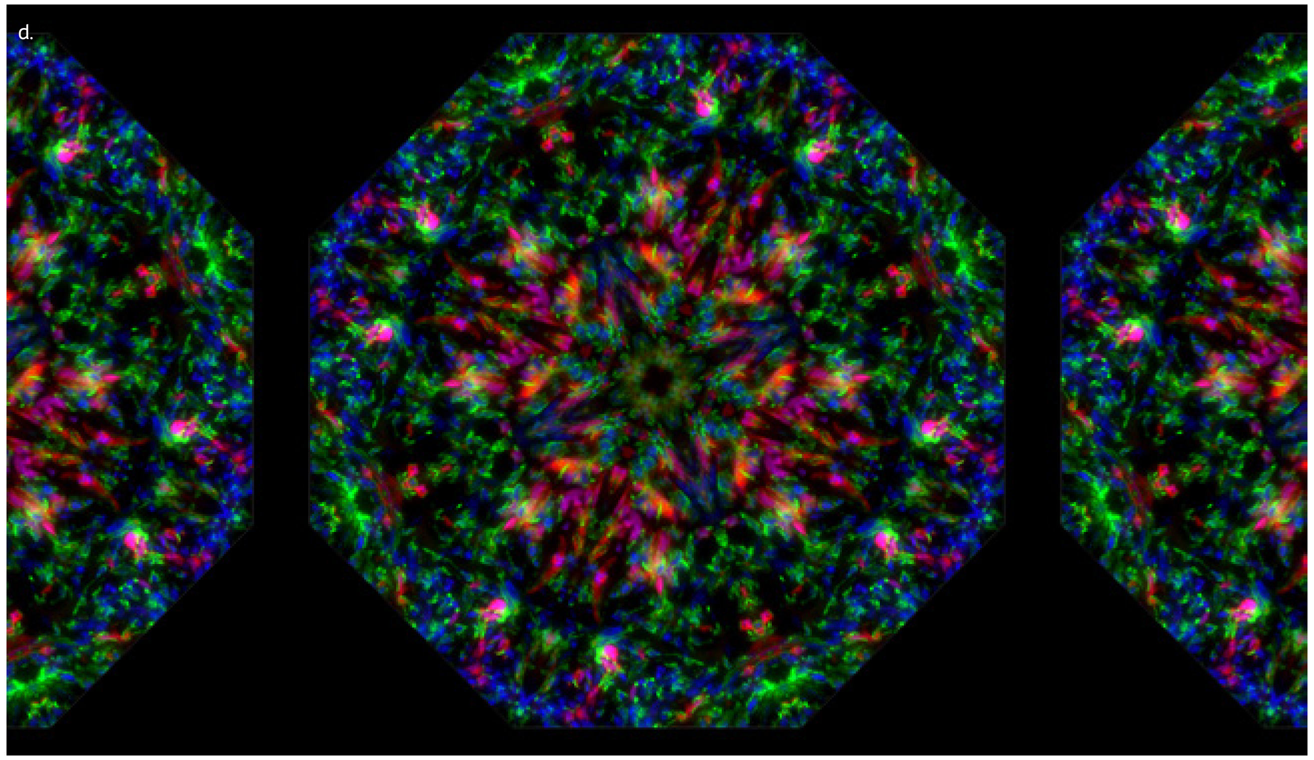
PROGRAMMER
27. Helge Gudmundsen

VISITING FELLOW
28. Ricardo Matias



Mouse cranial implant used in optogenetic experiments. Neurons are stimulated using the blue laser and their response is recorded through a coupled electrode array.

Scale bar: 5mm (photo courtesy Gabriela Martins)



Principal Investigator
BRUNO COSTA-SILVA

SYSTEMS ONCOLOGY LAB

Cancerous tumours do not grow in a vacuum. To develop and expand they depend on the active support of normal healthy tissue. Despite that, most current cancer research focuses on specific cancer types instead of observing the problem on a whole-organism systemic level. An innovative approach aims to gain a novel perspective on cancer by studying the mechanisms by which tumour cells utilize the body's innate forms of communication to recruit non-tumour cells to support tumour growth and metastasis.

Scientific Approach

The general interest of the Systems Oncology lab is to understand how crosstalk between tumour cells and non-tumour cells supports oncologic disease. Specifically, the lab studies how the exchange of extracellular vesicles, a natural form of communication in the body, can be utilized by cancerous tumours for growth and metastasis. Recent results from the team have shown not only that these vesicles are different in cancer patients, but also that they can activate healthy cells at remote locations to support tumours.

Following these results, the lab currently focuses on developing animal models of tumour initiation, progression and metastasis, in combination with characterization of extracellular vesicles isolated from tumour cell lineages and oncologic patients with diverse clinical profiles. By using this approach, the lab aims to gain mechanistic understanding of this form of communication with the end goal of developing tools for early detection, follow-up and treatment of cancer.

MAIN INTERESTS:
How the exchange of extracellular vesicles, a natural form of communication in the body, can be utilized by cancerous tumours for growth and metastasis

METHODS:
Flow cytometry, Cell culture and Animal models of cancer

MODEL /AREA OF FOCUS:
Mice / Whole organism

SYSTEMS ONCOLOGY LAB

LAB MEMBERS

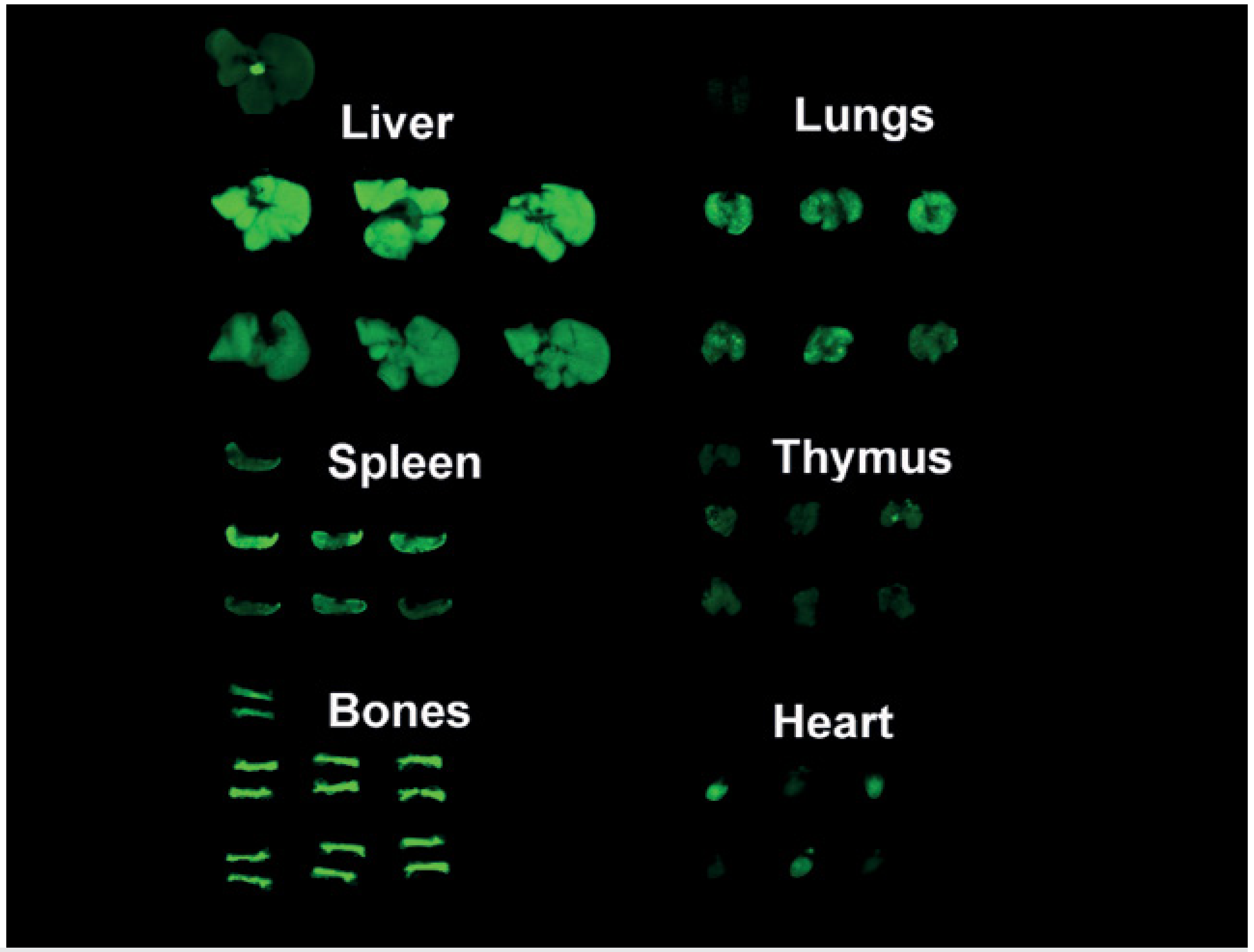
POSTDOCTORAL RESEARCHERS
1. Ana Gregorio
2. Sergio Caja Galan
3. Silvia Batista

PHD STUDENTS
4. Bruna Ferreira
5. Joana Maia
6. Julia Elzanowska
7. Marie Christine Semira
8. Nuno Couto

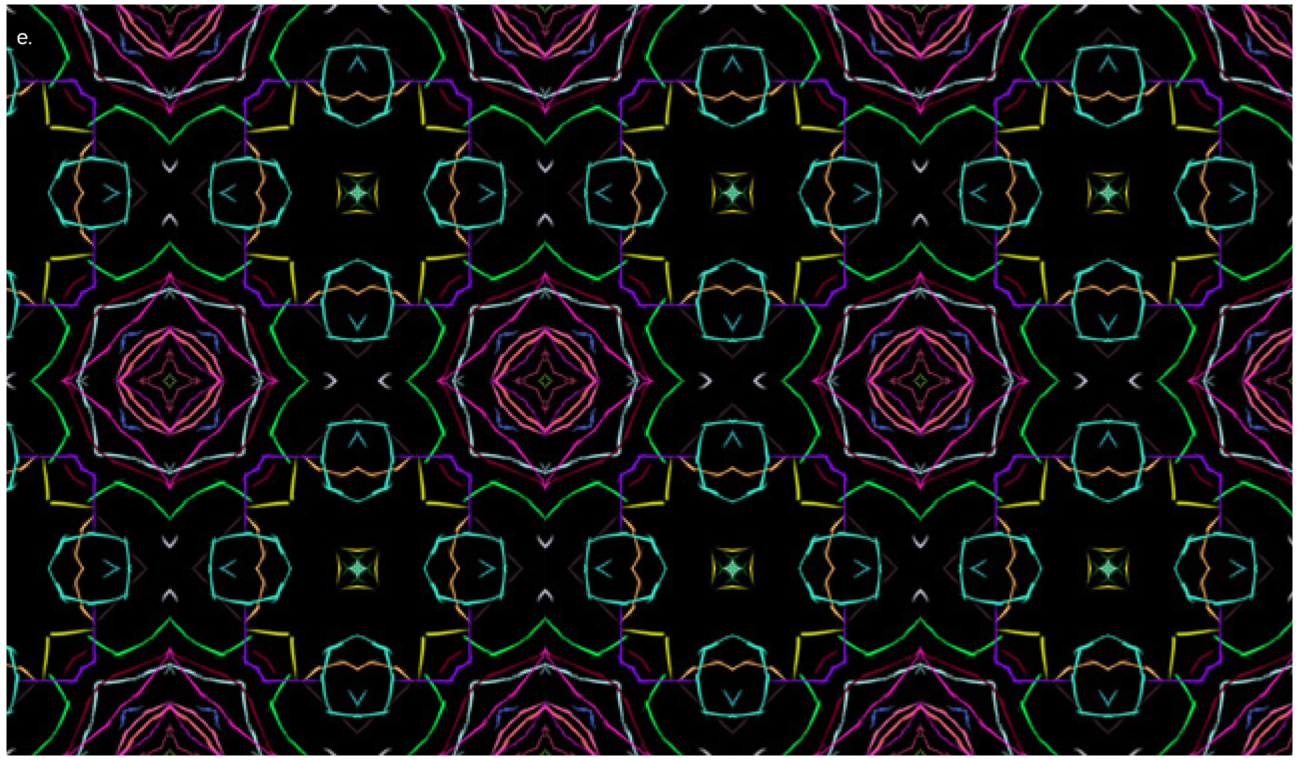
RESEARCH ASSISTANT
9. Maria Carolina Strano Moraes

RESEARCH TECHNICIAN
10. Christian Bodo

VISITING FELLOW
11. Andreia Otake



Tumour-derived exosomes biodistribution assay. After intravenous injection of fluorescently-labeled tumour-derived exosomes (green staining) in mice, organs are dissected and analysed for exosomes accumulation. In this study, multiple myeloma-derived exosomes displayed preferential accumulation in liver and bones when compared to other sites.



Principal Investigator
GONZALO DE POLAVIEJA

COLLECTIVE BEHAVIOUR LAB

Information processing can be achieved through the interaction of units in collectives. Examples of successful interactions are fish schools escaping predators, thinking by brains and learning in artificial networks. Though clearly central to the functioning of many systems, the properties that control the emergence of collective behaviour are still largely unknown. We aim at understanding how animals and machines can extract useful knowledge from data. Our approach is theoretical and experimental, and lies at the boundary of animal behaviour, neuroscience, machine learning, artificial intelligence and applied maths.

Scientific Approach

At the Collective Behaviour lab, a multidisciplinary team that includes mathematicians, physicists and biologists implements a diverse set of tools such as computational, behavioural and virtual reality approaches in zebrafish and humans. In this way, insights gained by genetic and molecular probing in zebrafish are used by the researchers to design models which they test and extend to human experiments. In addition, the lab also works on the development of tools and techniques aimed at obtaining richer datasets essential to the formulation of better models of collective behaviour.

In 2017, several publications by the lab have identified rules that capture how elements such as modulation of swimming speed and the choice of which conspecific to follow, help explain the emergence of schooling behaviour in fish.

MAIN INTERESTS:
Understand emergent properties in collectives of interacting units

METHODS:
Behaviour, Mathematical modelling and Machine learning

MODEL /AREA OF FOCUS:
Zebrafish, Humans / Whole brain

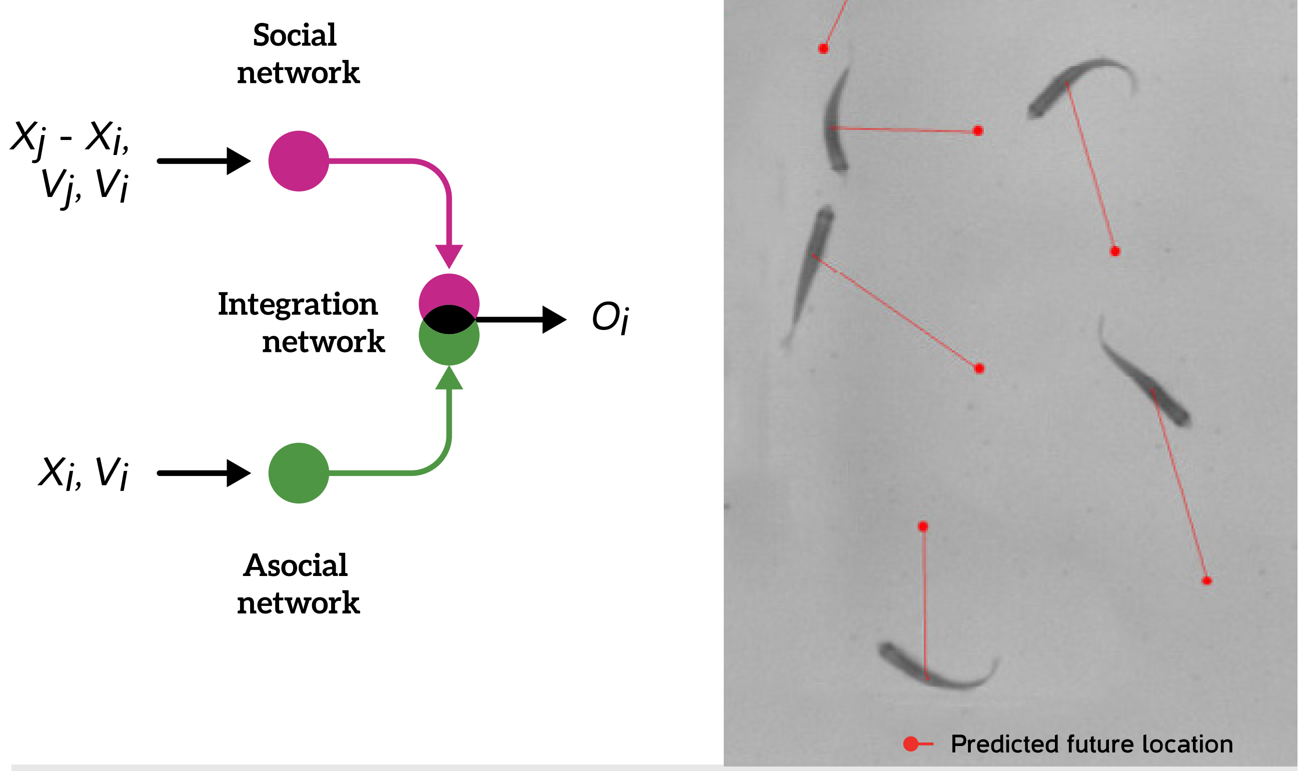
COLLECTIVE BEHAVIOUR LAB

LAB MEMBERS

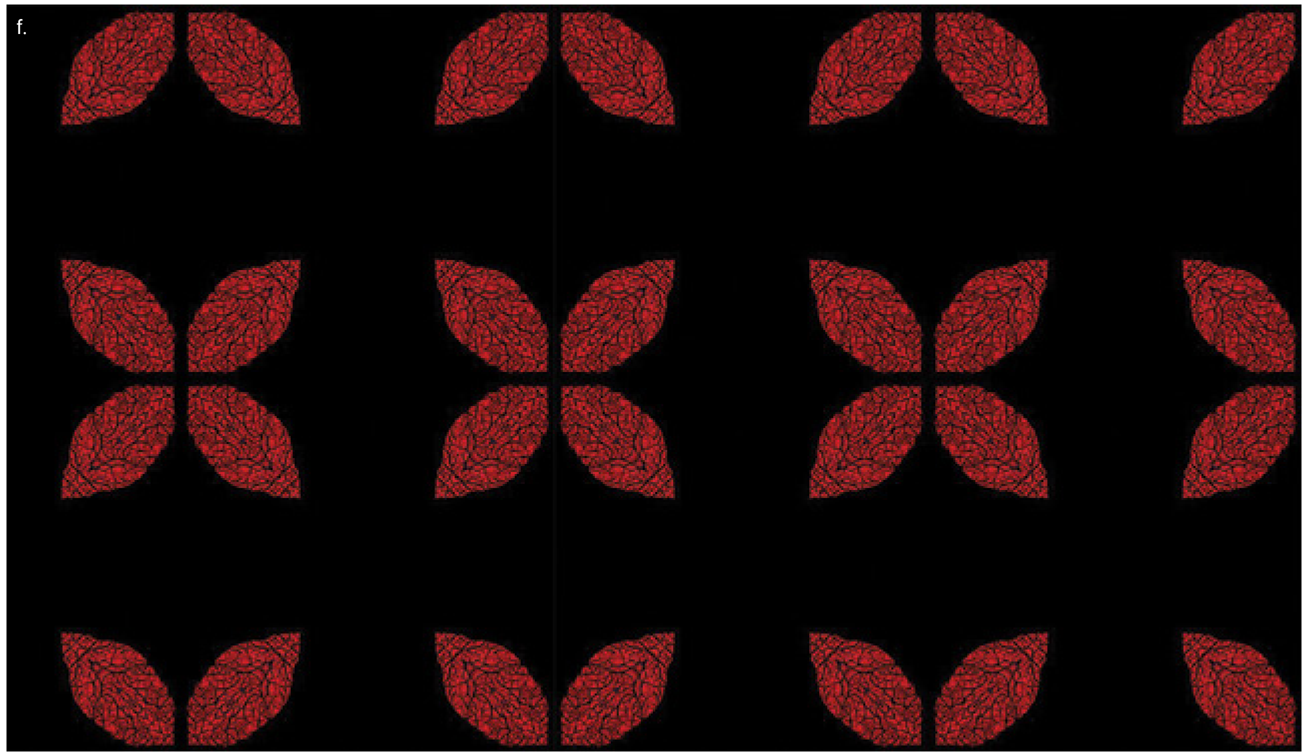
POSTDOCTORAL RESEARCHERS
1. Robert Hinz
2. Francisco J. Heras
3. Mattia Bergomi

PHD STUDENTS
4. Andres Laan
5. Antonia Groneberg
6. Francisco Romero
7. Marta Iglesias
8. Victoria Brugada

Patterns of collective animals behaviour



A neural network (left) separating social and non-social inputs can be trained to predict the patterns of collective animals behaviour (right).



Principal Investigator
SUSANA LIMA

NEUROETHOLOGY LAB

Life without sex and reproduction would not only be less interesting, it would be impossible. Yet, despite its importance for the existence of the species, unlike feeding, it is not actually necessary for the survival of the individual. Still, nature developed "ways" to ensure animals do engage in sex, such as making it highly rewarding. But on the other hand, sexual behaviour must also be tightly controlled, as sex can put animals at risk by placing them in a defenseless position. Given this complicated balance of benefits and risks, how does the brain ensure that animals engage in safe and productive sexual processes?

Scientific Approach

The Neuroethology lab focuses on several variables that influence sexual behaviour in mice. For one, as the willingness of females to engage in sex is limited to periods of fertility, the team investigates how sex hormones modulate neural activity and behaviour throughout the female reproductive cycle. Second, the team also studies the mechanisms that ensure termination of sexual interaction in males. Finally, as reward is a central component in sexual behaviour, the team also studies reward processing in the brain. To gain insight into how the brain controls these fundamental processes, the team uses a variety of techniques, including electrophysiology, genetically-based imaging methods, anatomy and many different behavioural paradigms designed to address these various aspects of sexual behaviour.

The team works on several brain regions, but most of their efforts are centered on the ventral tegmental area, which is fundamental for reward processing and learning and on the medial hypothalamus, an area that is particularly important for female sexual behaviour. In fact, recent advances in the lab include the establishment of the medial hypothalamus as a brain region where hormonal state and social information are integrated.

In 2017, the team leader, Susana Lima, was awarded a Consolidator Grant from the European Research Council to advance the team's works towards establishing how the reproductive hormones affect the brain to control female sexual behaviour.

MAIN INTERESTS:
How the brain controls key processes in sexual behaviour

METHODS:
Electrophysiology, Optogenetics, Anatomy and Behaviour

MODEL / AREA OF FOCUS:
Rodents / Medial Hypothalamus, Ventral Tegmental Area

NEUROETHOLOGY LAB

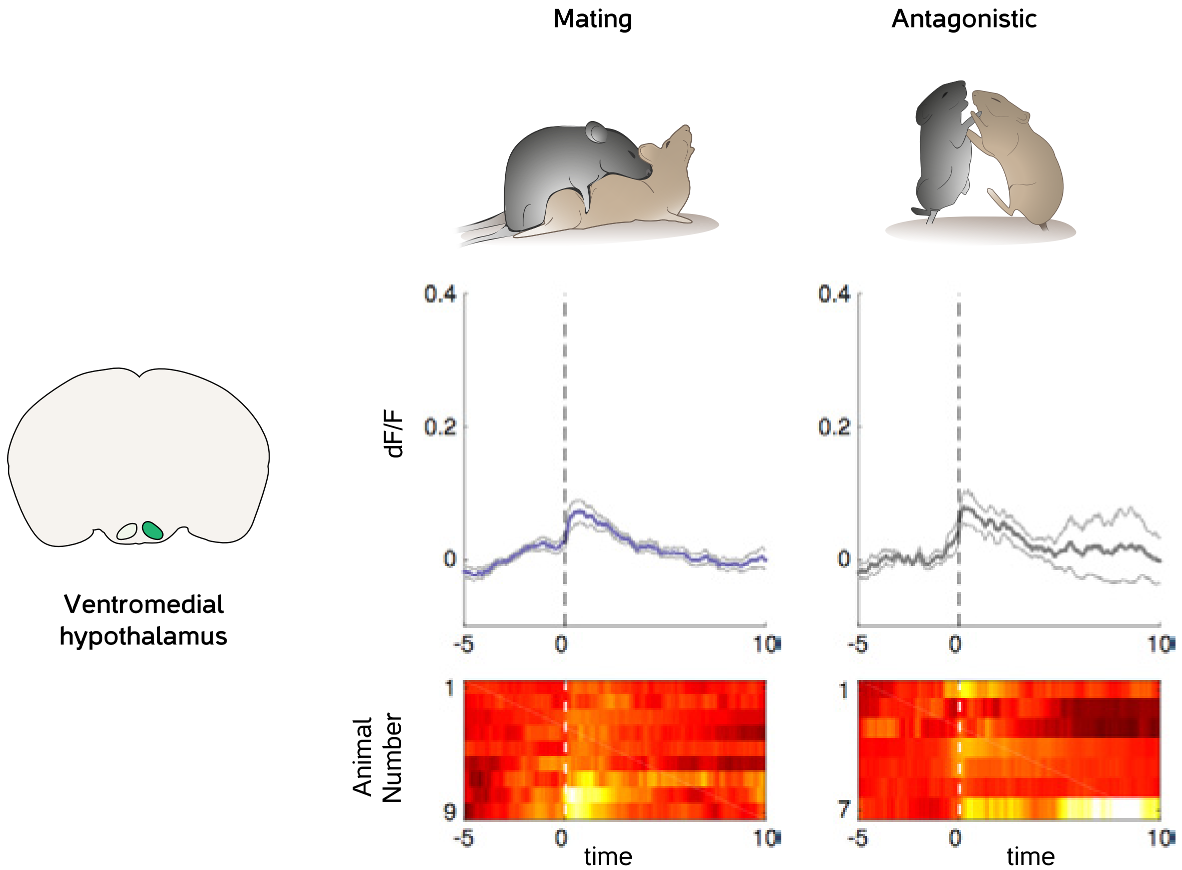
LAB MEMBERS

POSTDOCTORAL RESEARCHERS
1. Constanze Lenschow
2. Francisco Esteves

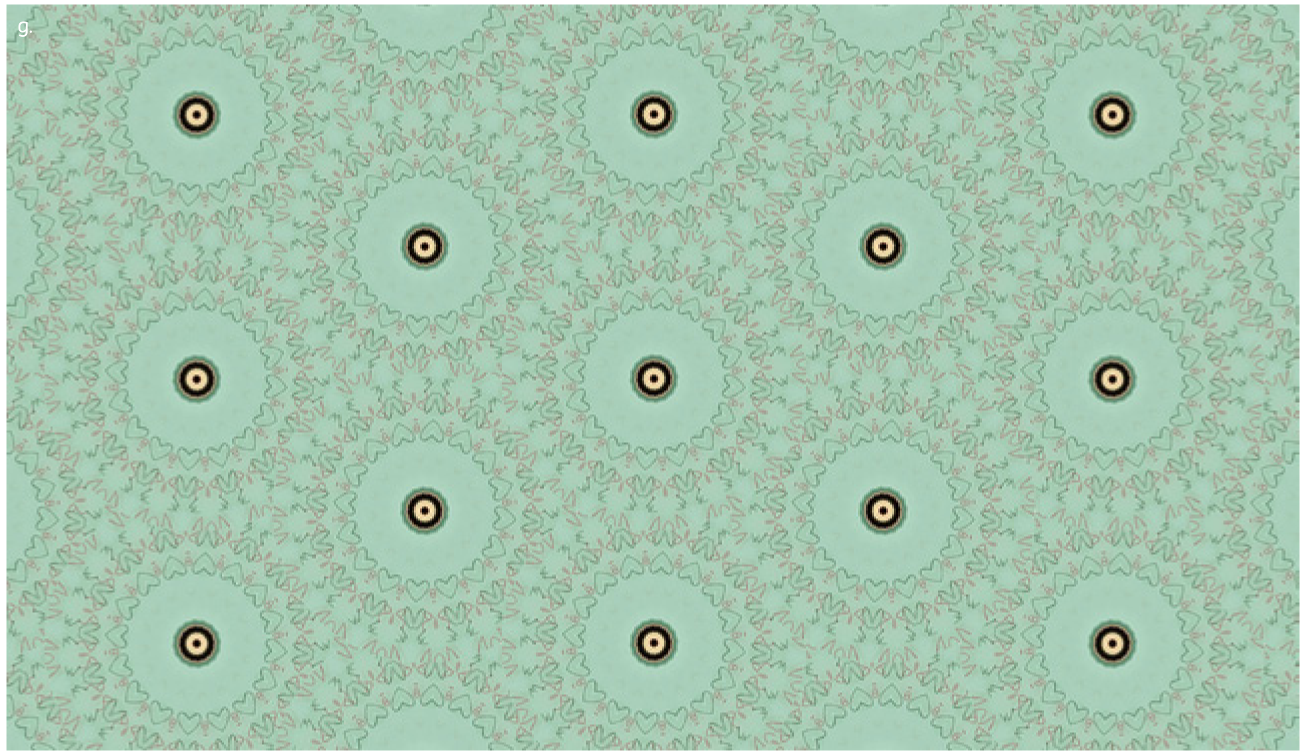
PHD STUDENTS
3. António Dias
4. Basma Husain
5. Baylor Brangers (Co-supervision with Zachary Mainen)
6. Luís Moreira
7. Silvana Araújo
8. Susana Valente

MSC STUDENTS
9. Ana Rita Mendes
10. Inês Preguiça
11. Diogo Matias

RESEARCH TECHNICIAN
12. Margarida Duarte



The ventromedial hypothalamus is active not only during mating (left), but also during antagonistic behaviour (right).



Principal Investigator
CHRISTIAN MACHENS

THEORETICAL NEUROSCIENCE LAB

Major breakthroughs in science are often accompanied by the identification of a mathematical way to describe complex phenomena, such as Newton's laws of motion, or the three dimensional structure of DNA. In neuroscience, we largely lack a clear mathematical description of how the brain processes incoming sensory information in order to choose the right action. Since these processes involve the coordinated activity of large populations of neurons, they are intricately complicated and pose one of the biggest mysteries in the field of neuroscience. Big because little is understood at this point and complicated because it involves many interconnected autonomic units (neurons), which are intrinsically complex.

Scientific Approach

To develop models of information processing in the brain, the Theoretical Neuroscience lab uses mathematical analysis and numerical simulations. These tools allow the researchers to formulate their ideas and intuitions in a precise manner and thereby put them to a test using real data. Specifically, the team focuses on several 'higher-order' regions such as the frontal cortices that are involved in turning sensory information into decisions.

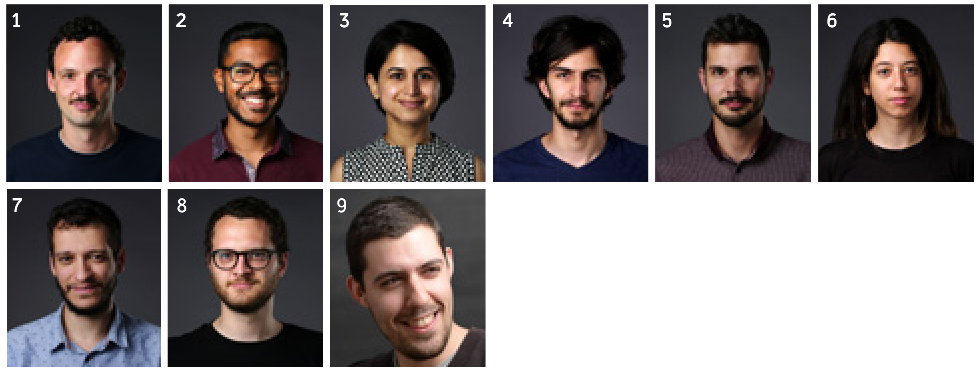
The team is currently developing methods to summarise the activity of neural populations in useful ways and to compare population activity across areas. In turn, the researchers seek to relate the population activity to behavioural, computational, and mechanistic problems or constraints that organisms are facing. They work in close collaboration with several experimental labs, both within and outside of the Champalimaud Centre for the Unknown.

MAIN INTERESTS:
Formulating computational theories of brain function and animal behaviour

METHODS:
Mathematical Analysis, Numerical Simulations

MODEL / AREA OF FOCUS:
Monkeys, Rodents, Zebrafish / Brain Region: Frontal Lobes, Visual Cortex, Auditory Cortex, Striatum, Hindbrain

THEORETICAL NEUROSCIENCE LAB



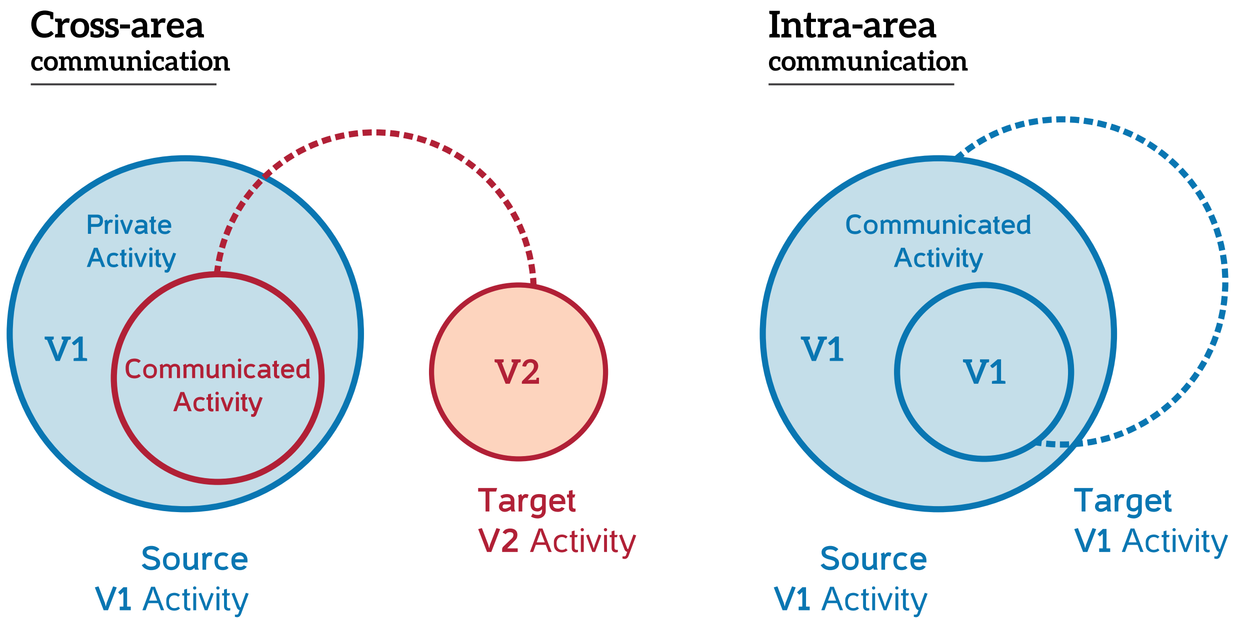
LAB MEMBERS

POSTDOCTORAL RESEARCHERS

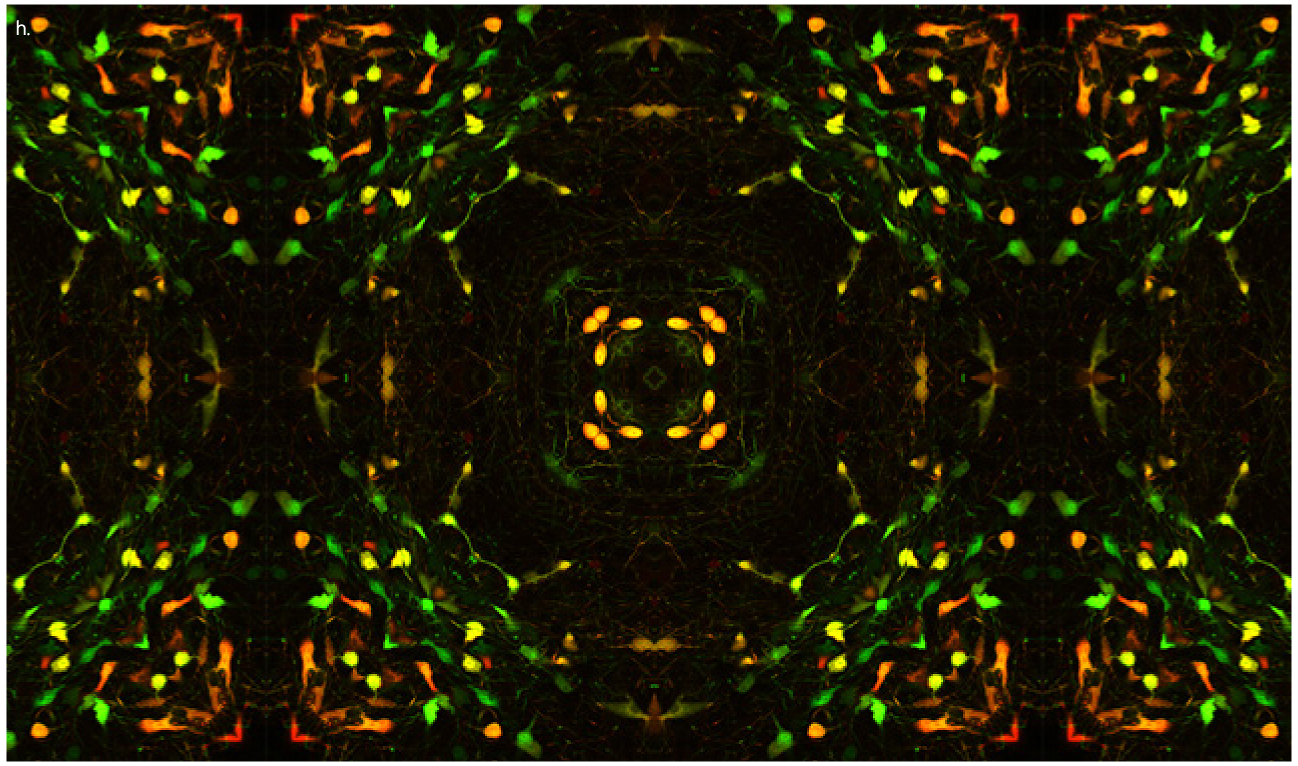
1. Adrien Jouary (Co-supervision with Michael Orger)

PHD STUDENTS

2. Allan Mancoo
3. Asma Motiwala (Co-supervision with Joe Paton)
4. Gonçalo Guiomar (Co-supervision with Joe Paton)
5. Michael Pereira (Co-supervision with Rui Costa)
6. Oihane Horno (Co-supervision with Leopoldo Petreanu)
7. Nuno Calaim
8. Severin Berger
9. Joao Semedo (Co-supervision with Byron Yu, Carnegie Mellon)



How two brain areas communicate. Left, cross-area communication: only some activity patterns from a source area (V1) are communicated to a target area (V2), see red circles. All other activity patterns remain private to the source area (V1). Right, intra-area communication: all activity patterns are shared within a brain area.



SYSTEMS NEUROSCIENCE LAB

Principal Investigator
ZACHARY MAINEN

SYSTEMS NEUROSCIENCE LAB

We do not perceive the world directly. Rather, our brains must decipher what is out there using the window of information we receive from our senses. The result of this process is referred to as a 'model' of the world. Understanding how brains construct and use internal models is a central problem in neuroscience. This problem can be approached by thinking of the brain as a kind of an intuitive scientist, collecting and analysing data, constructing and testing hypotheses based on those data, and revising them in light of new data. Each brain gets different data and produces a different model, making the beliefs that guide our actions subjective and sometimes wrong. Fortunately, like a good scientist, our brains can and do evaluate the quality of the data. This gives us a sense of confidence in our beliefs and decisions, helping us to know when our subjective reality is worth acting on and when to question it. Understanding how all this works in terms of neural circuits is the long-term goal of research in the Systems Neuroscience lab.

Scientific Approach

Until recently, most research on cognitive phenomena, such as perception and decision-making was done mainly in human and non-human primates. Together with a handful of colleagues, Mainen, head of the System Neuroscience lab, has helped to show that rodents in fact share many of primates' cognitive abilities. Indeed, in 2008, his lab was the first to discover neural activity that reflected decision confidence in any species, a feat that was done in rats. Though research projects with human subjects have more recently started in the lab, this approach still dominates the Systems Neuroscience lab today, where rodents are the stars, allowing the use of advanced genetic and molecular tools not available in humans and non-human primates. Using these tools, the team is able to combine multiple techniques, which allow them to record and manipulate the neural circuits that control confidence and decision-making in relevant brain regions, such as the cortex and the midbrain. The team places a major focus on the midbrain serotonin system, which they believe to play a key role, along with other neuromodulators, in regulating learning and decision-making. Theory and modeling are also a vital component of the work done in the lab because of the inherent complexity involved.

The members of the Systems Neuroscience lab are a diverse group, with backgrounds ranging from biology to mathematics, engineering and even philosophy. Lab members also count on collaborations with many groups at the CR.

MAIN INTERESTS:
How brains use perceptual information to create and act on models of the world, the role of confidence, uncertainty and neuromodulators in these processes

METHODS:
Optogenetics, Theory, Behaviour, Electrophysiology

MODEL /AREA OF FOCUS:
Rats, Mice, Humans/ Cortex, Raphe Nuclei

LAB MEMBERS

RESEARCH ASSOCIATE
1. Eran Lottem

POSTDOCTORAL RESEARCHERS
2. Bassam Atallah
3. Cindy Poo
4. Eric DeWitt
5. Fanny Cazettes
6. Gautam Agarwal
7. Niccolò Bonacchi
8. Maria Joana Rigato
9. Masayoshi Murakami
10. Nicolas Gutierrez
11. Sara Matias
12. Romain Ligneul

PHD STUDENTS
13. Baylor Brangers (Co-supervision with Susana Lima)
14. Pietro Vertechi
15. Dario Sarra
16. Madalena Fonseca (Co-supervision with Noam Shemesh)
17. Samuel Viana (Co-supervision with Jose Pedro Serra)

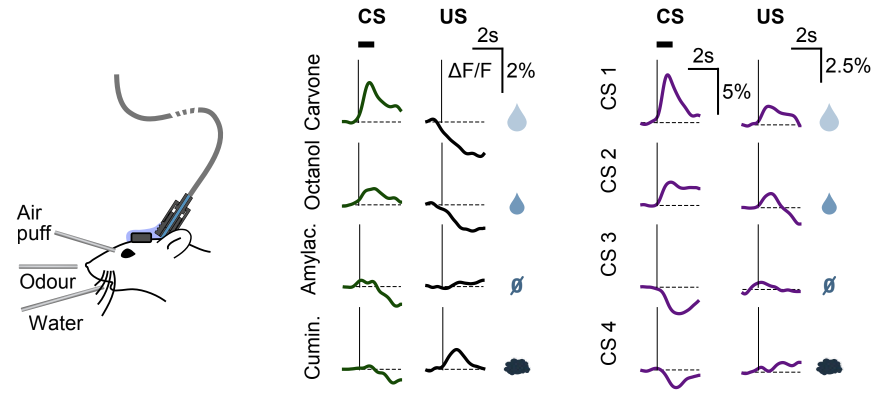
MSC STUDENTS
18. Beatriz Godinho
19. Tiago Quendera

RESEARCH TECHNICIANS
20. Margarida Duarte
21. Megha Patwa

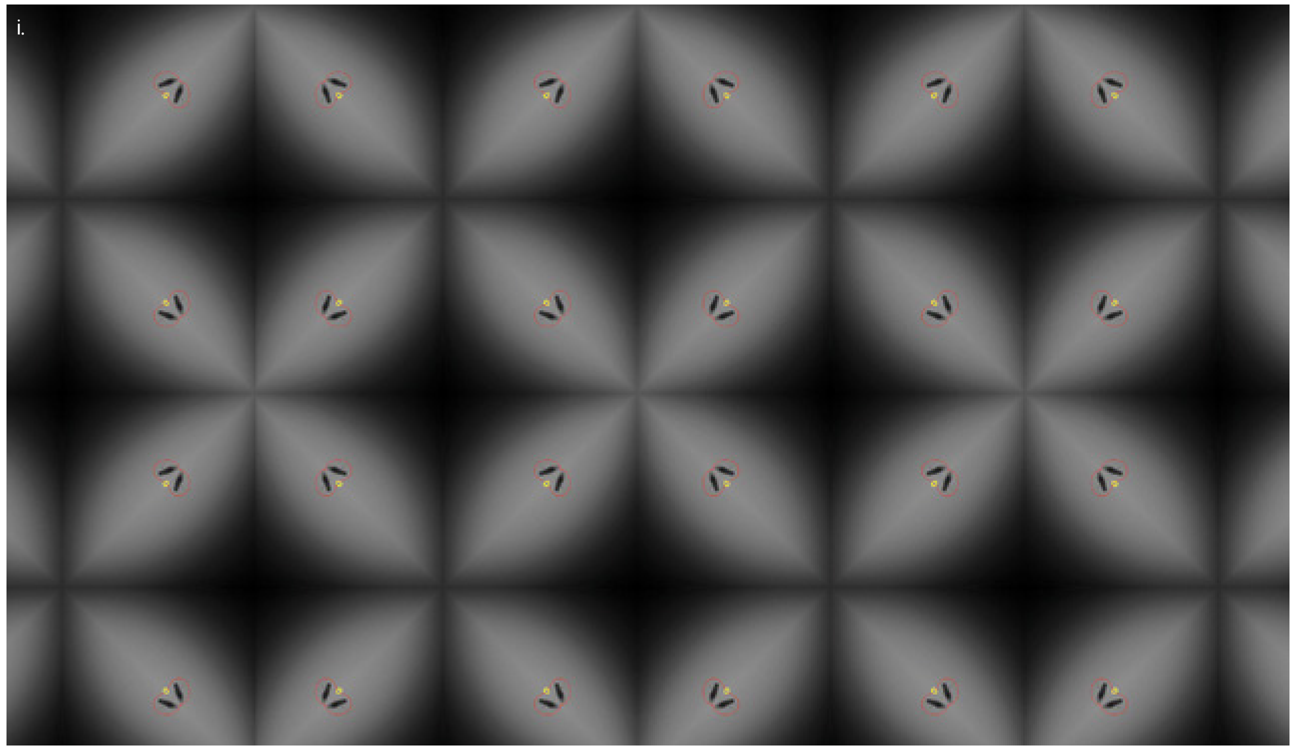
RESEARCH ASSISTANTS
22. Inês Laranjeira
23. Solène Sautory

LAB MANAGERS
24. Ana Nunes
25. Catarina Pimentel

VISITING SCIENTISTS
26. Paul Bush
27. Rita Venturini



Using fiber photometry, we can record neuronal activity in mice performing learnt tasks. Four different odours (conditioned stimulus, CS) were associated with four different outcomes (unconditioned stimulus, US): positive (big or small water drops), neutral (absence of outcome) or aversive (air puff to the eye). Similarly to dopamine neurons (DA) - a neuromodulator involved in learning through reward processes - serotonin neurons (5-HT) are activated by reward-predicting cues. SSING



Principal Investigator
MARTA MOITA

BEHAVIOURAL NEUROSCIENCE LAB

Behaviours that are crucial for survival are likely to have shaped the brain throughout evolution. Animals face a multitude of dangers, many of which can be life threatening, such as attacks by predators and insufficiency of vital resources. Therefore, several mechanisms of defensive behaviours have evolved, of which many are similar across the animal kingdom. In addition, social behaviour, is crucial for survival in many species. Living in groups provides a number of advantages such as help with defence, through the sounding of alarm signals for example, and the division of labour, such as when groups of females share the care of their young. These two different types of behaviour raise many questions such as how animals detect threats in the environment, how they choose which defensive strategy to adopt and what drives animals to cooperate with each other.

Scientific Approach

To address these questions, the Behavioural Neuroscience lab uses two different animal models, rats and fruit flies. To study how animals use cues from conspecifics for threat detection, the team uses rats. A great deal is known about the brain mechanisms that drive defensive behaviours in rodents, though those by which social information is used to detect threats remains largely unanswered. To address this question the lab develops new behavioural tasks that allow the dissection of the social cues used by rats. At the brain level, the team focuses on the amygdala, a structure that regulates defensive responses and the areas that send information to it. To do so, experiments in the lab combine genetically based techniques and pharmacology to manipulate the activity of neurons in the brain regions of interest. Once a threat is detected, animals need to choose the appropriate action. Many times defensive behaviours are carried out at the level of the population, such as shoaling in fish. To investigate the neural mechanisms of social defense responses, the team uses the fruit fly, an 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. The team is currently developing an assay to dissect social defensive behaviours in flies across large groups of individuals.

MAIN INTERESTS:
Defensive and social behaviour

METHODS:
Development of behavioural tasks, Optogenetics, Pharmacology, Physiology

MODEL /AREA OF FOCUS:
Rat and Fruit flies / Amygdala, Auditory thamalus, Cortex

BEHAVIOURAL NEUROSCIENCE LAB

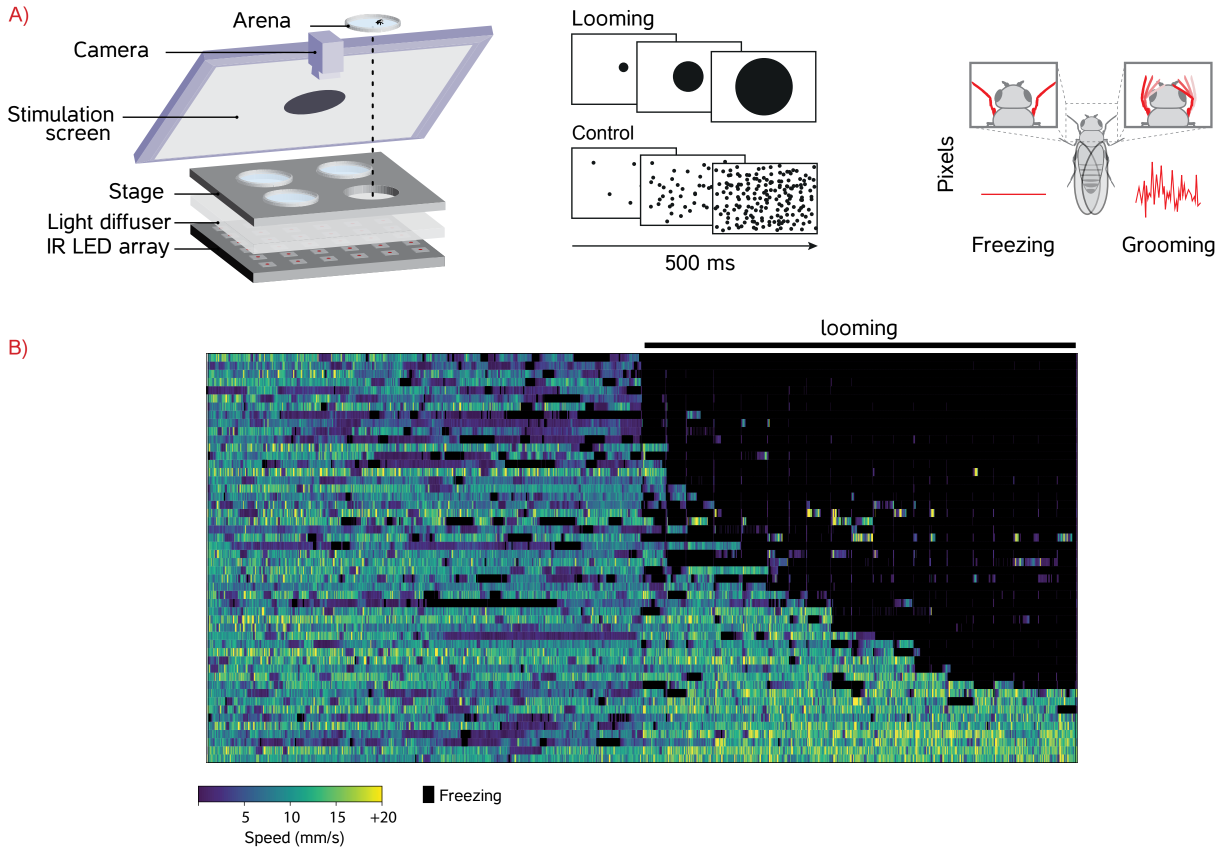
LAB MEMBERS

POSTDOCTORAL RESEARCHERS
1. Clara Ferreira
2. Natalia Barrios
3. Ricardo Neto Silva
4. Scott Rennie

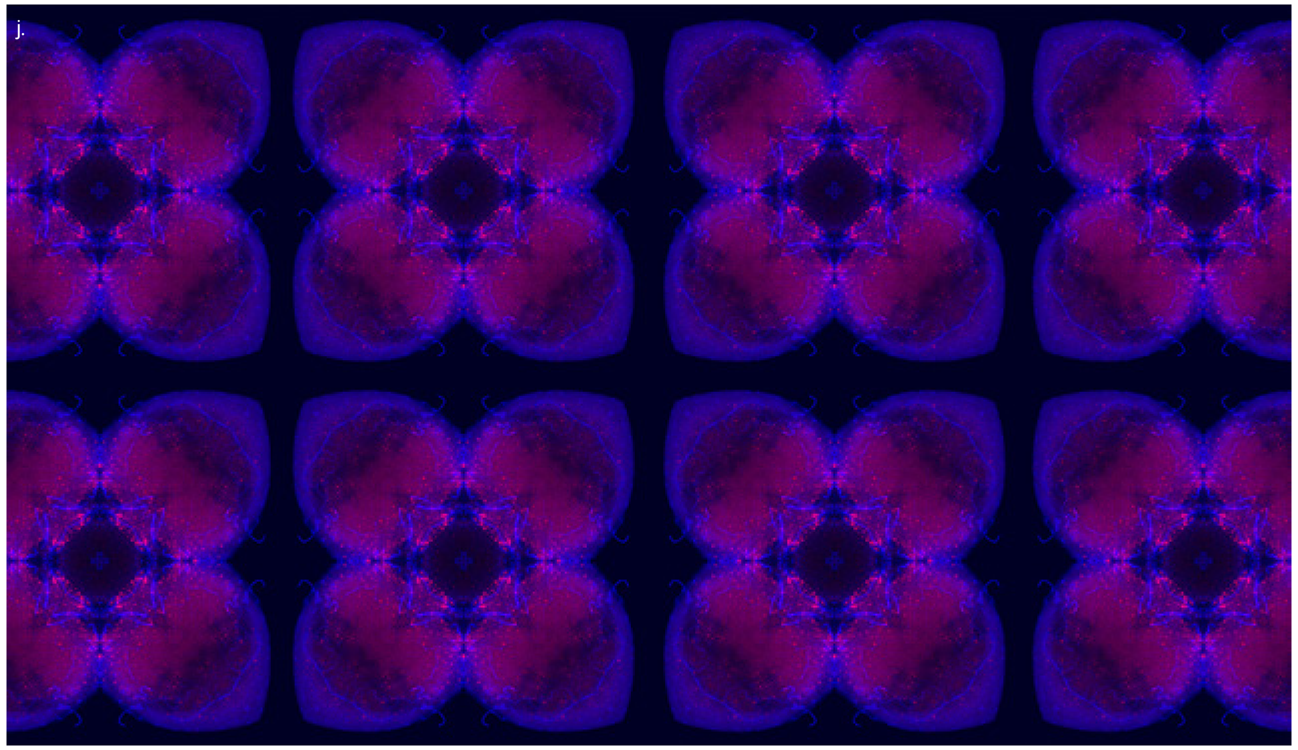
PHD STUDENTS
5. Andreia Cruz
6. Ricardo Zacarias

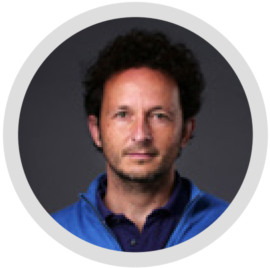
MASTER'S STUDENTS
7. Mirjam Heinemans

RESEARCH TECHNICIANS
8. Alexandra Medeiros
9. Matheus Farias



(A) Schematic of behavioural assay; (B) Schematic of visual stimuli; (C) A pixel change classifier was created to automatically detect freezing bouts; (D) Speed raster for a random subset of 50 flies ordered by time spent freezing stimulation (ascending). Each row corresponds to one fly and each vertical line to 500 ms bins. Bar on top indicates the stimulation period.





Principal Investigator

EDUARDO MORENO

CELL FITNESS LAB

Like humans, single cells grow old and their performance decays through use and damage. And just as we are able to detect fitness decay in our human colleagues by looking at the graying of their hair, or the wrinkles in their faces, so are cells able to recognise decay in their neighbours. Once cells recognise an unfit neighbour they bring about its death and often replace it with a younger, healthier cell. Despite the crucial importance of this fundamental process and its implication into several broader fields, such as development, ageing, regeneration and cancer, the molecular mechanisms that underlie it are only now starting to be uncovered.

Scientific Approach

To uncover the mechanisms of cell competition, the Cell Fitness lab studies its role in processes such as ageing, development, tissue regeneration and cancer. Work from the team has provided significant insight into these mechanisms, including the identification of "fitness fingerprints", a molecular code used by cells to exhibit their fitness level. The team has demonstrated how those fitness fingerprints are exhibited by less-fit cells and can be used to mediate cell selection by allowing neighbouring cells to recognise and eliminate these cells. The team has shown that this process happens during ageing, regeneration and cancer. Specifically, they found that fitness-based cell selection could be manipulated to delay ageing and tissue fitness decay as well as to prevent the expansion of cancer cells (cancer cells often exhibit themselves as "super-fit" cells, which leads normal healthy cells around them to be eliminated using this same mechanism of cell competition). The team has also discovered a new type of competition named "mechanical competition" in which high density of cells leads to compression of tissue and thereby to cell elimination. The team proposes that this process may be important for tumor expansion into healthy tissue and are currently in the process of testing this hypothesis.

Work in the lab is done in the fruit fly animal model, where advanced genetic techniques are applied to manipulate the functions of genes related to cell fitness, in combination with microscopy and live imaging used to track how different genetic manipulations influence cell competition. Specifically, the team studies epithelial tissue, which is known to give rise to 95% of cancer types, including breast, lung and skin cancer. They also study the role of fitness based cell selection among neurons during brain development, neurodegeneration and brain ageing. They are also currently studying the conservation of the process in human cells and in mouse models.

MAIN INTERESTS:
The mechanisms by which cells of multicellular animals perform fitness detection and selection of neighboring cells.

METHODS:
Genetics, Microscopy, Live Imaging

MODEL / AREA OF FOCUS:
Human cells, Mice, Fruit Flies / Epithelial and Neuronal Tissue

CELL FITNESS LAB

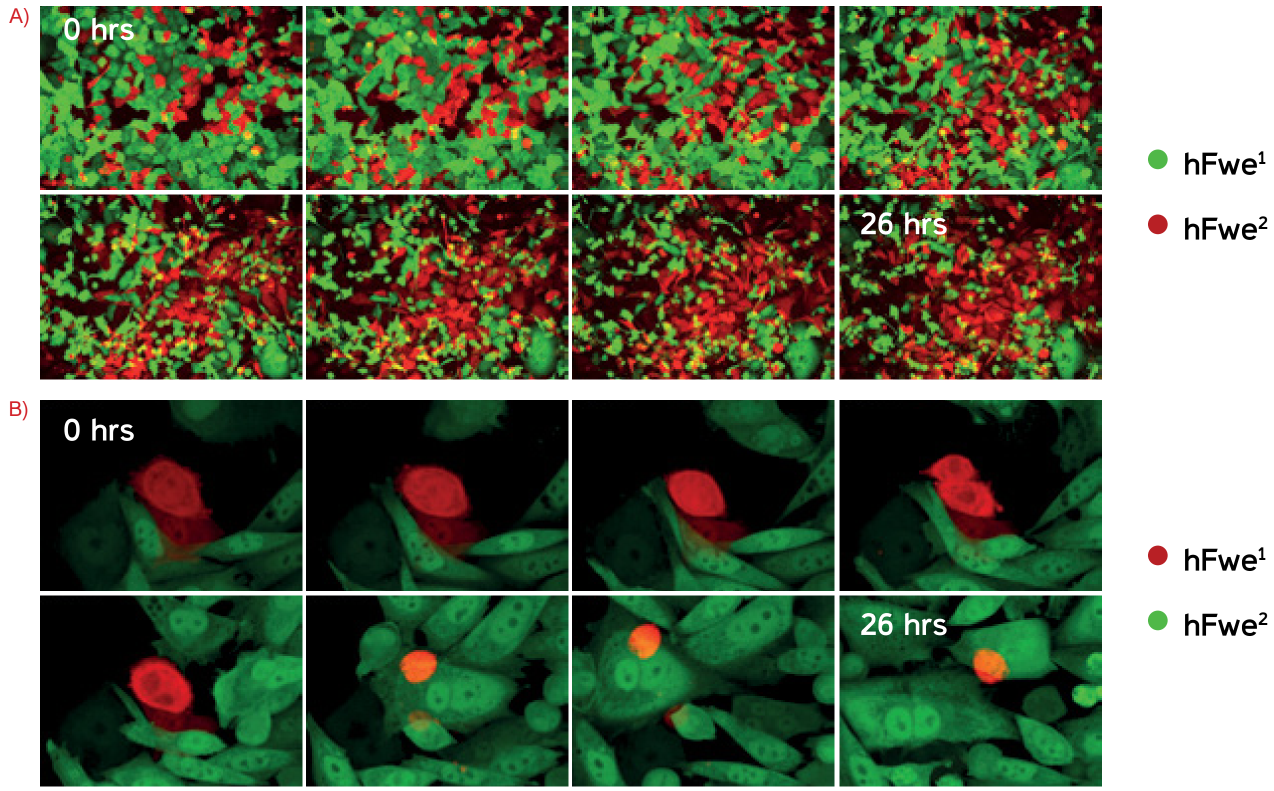
LAB MEMBERS

POSTDOCTORAL RESEARCHERS
1. Catarina Brás Pereira
2. Dina Coelho da Silva

PHD STUDENTS
4. Andrea Spinazzola
5. Andrés Gutiérrez
6. Denise Camacho
7. Irene Argudo
8. Maria Bettencourt
9. Maria Carolina Rodrigues

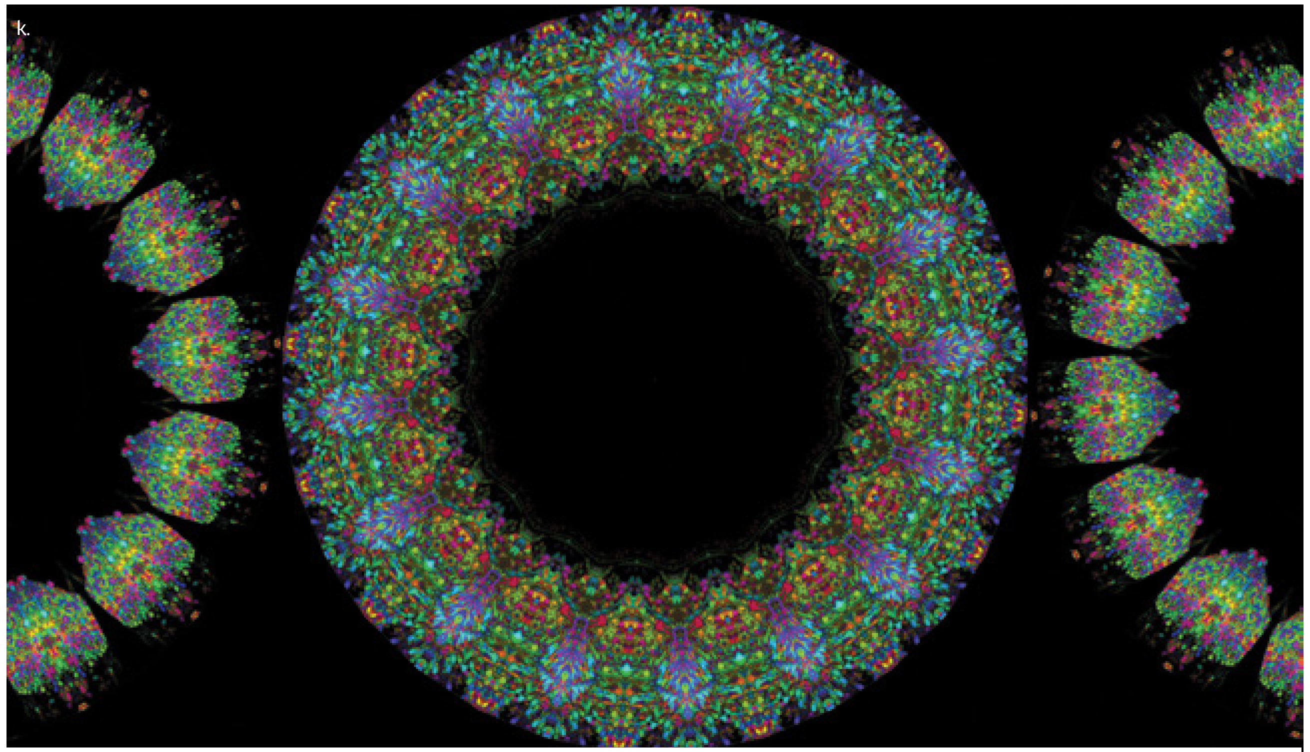
MASTER'S STUDENTS
10. Inês Silva
11. Ana Catarina Rato
12. Mariana Marques dos Reis
13. Pedro Durão

VISITING SCIENTIST
13. Esha Madan
14. Rajan Gonga



A) High-resolution live cell imaging experiment (28 hr) showing cell competition in MCF-7 $hFwe^{KO}$ cells expressing $hFwe^{1\text{-IRES-GFP}}$ and $hFwe^{2\text{-IRES-RFP}}$ isoforms. The co-culture results show elimination of cells carrying Lose isoform ($hFwe^{1\text{-IRES-GFP}}$). The population of RFP+cells is significantly higher at 24 h than at 0 h in this combination, indicating that competition amongst $hFwe^{1\text{-IRES-GFP}}$ and $hFwe^{2\text{-IRES-RFP}}$ cells was observed. Cells expressing $hFwe^{2}$or $hFwe^{4}$ emerge as winners when co-cultured with cells expressing $hFwe^{1}$or $hFwe^{3}$ regardless of GFP or RFP reporter.

B) Single cell high-resolution live cell imaging experiment (28 hr) showing cell competition in MCF-7 $hFwe^{KO}$ cells expressing $hFwe1^{\text{-IRES RFP}}$ and $hFwe^{2\text{-IRES-GFP}}$ isoforms. The co-culture results show elimination of cells carrying lose isoform ($hFwe^{1\text{-IRES RFP}}$).



Principal Investigator

MICHAEL ORGER

VISION TO ACTION LAB

Standing on the beach on a clear, sunny day you are watching the waves when you suddenly notice an airborne object speeding towards you. Do you jump out of its path, or do you try to catch it? Your reaction depends on your brain's ability to extract relevant features of sensory visual input and guide appropriate motor actions. Similar reflexive behaviours can also be seen in zebrafish larvae that, at just a week old, are naturally able to escape predators, or catch a prey. Though seemingly relatively simple, reflexive behaviours such as these actually depend on activity generated in complex networks of neurons that are distributed across the entire brain. Discovering how these dynamics unfold throughout the brain on the level of single neurons during behaviour is crucial in order to formulate the principles on which these sensorimotor circuits are organised.

Scientific Approach

To tackle these challenges, the Vision to Action lab uses a combination of advanced optical, genetic and behavioural methods in zebrafish. In recent years, zebrafish have emerged as an attractive model system, as they exhibit a robust set of instinctive visually guided behaviours, while their brain, which follows a typical vertebrate pattern, is sufficiently small and transparent so that researchers can non-invasively image the activity of each of its neurons. Specifically, the team follows the activity of neurons by imaging changes in calcium levels inside neurons, a marker of neural activity, while performing high-speed behaviour tracking to make a detailed, quantitative analysis of visually evoked swimming and eye movements. In addition, the team develops genetic tools in order to probe and manipulate defined circuit elements with high specificity.

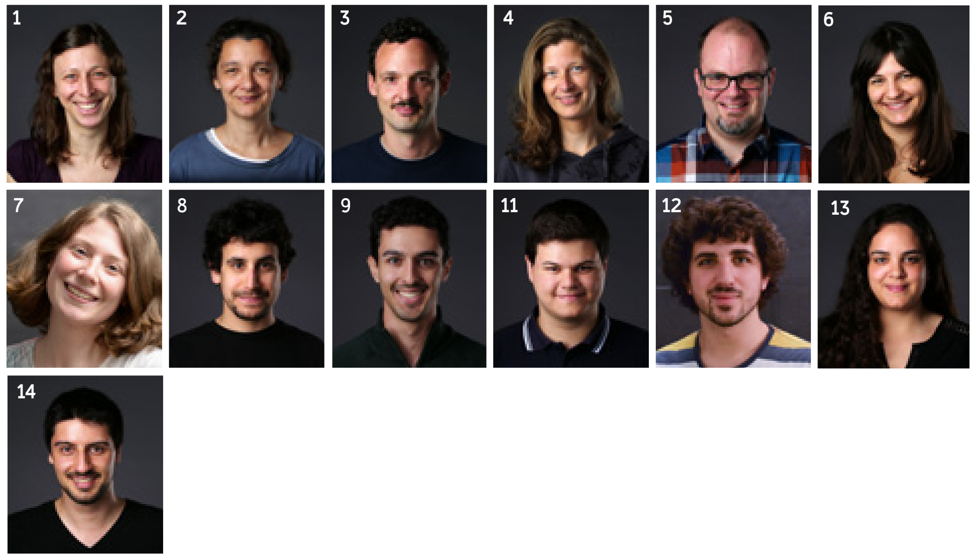
Recent work from the lab described, at single neuron resolution, the neural activity dynamics throughout the brain of behaving zebrafish. While even very simple behaviours involve activity in hundreds of neurons distributed across many brain regions, the team found that these elaborate patterns are consistent across individuals down to a very fine anatomical spatial scale. In addition, the team has also developed a high-speed, real-time tracking system that has allowed them to systematically characterise the swimming behaviour of zebrafish larvae in response to a variety of different stimuli. Using a computational approach to behaviour classification, called unsupervised machine learning, they have identified a core set of swimming movements, and demonstrated how they are used flexibly across different behaviours.

MAIN INTERESTS:
Determine the principles on which sensorimotor circuits are organised and reveal how activity dynamics unfold throughout the whole brain during behaviour

METHODS:
High-speed behaviour tracking, 2-photon calcium imaging, Light-sheet microscopy, Optogenetics

MODEL / AREA OF FOCUS:
Zebrafish / Whole brain

VISION TO ACTION LAB



LAB MEMBERS

RESEARCH ASSOCIATE
1. Claudia Feierstein
2. Ruth Diez del Corral

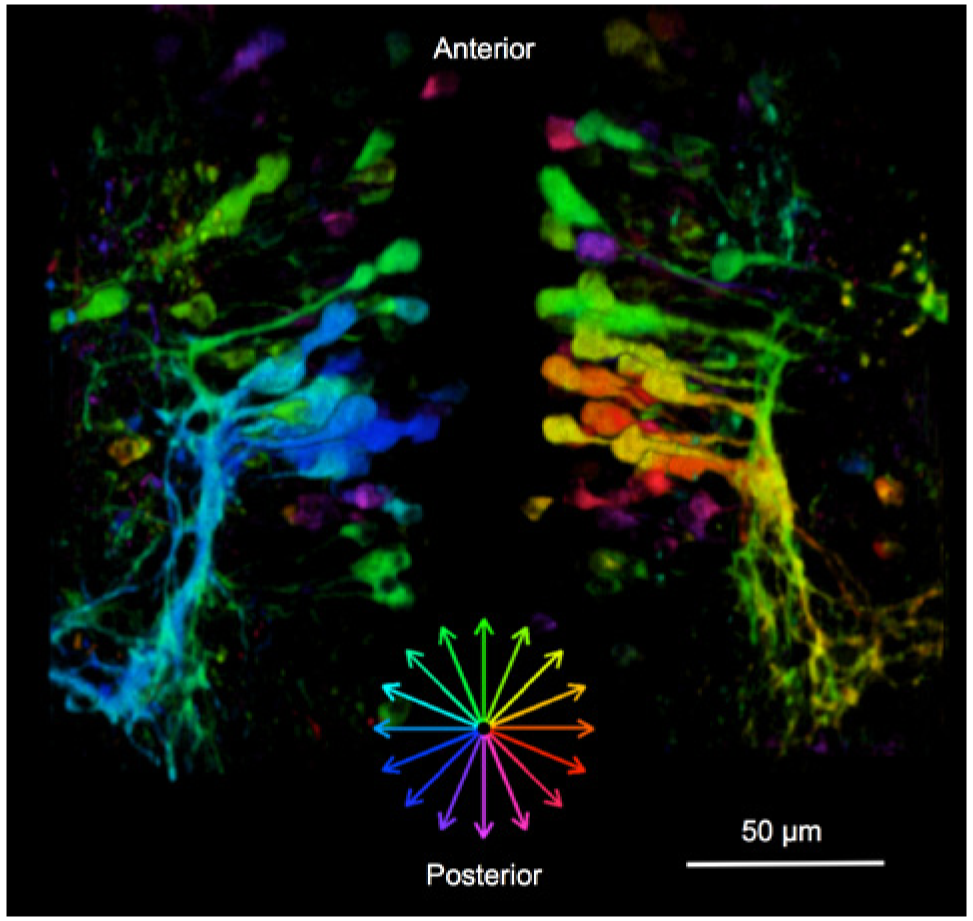
POSTDOCTORAL RESEARCHERS
3. Adrien Jouary (Co-supervision with Christian Machens)
4. Sabine Renninger

PHD STUDENTS
5. Jens Bierfeld
6. Rita Félix (Co-supervised with Megan Carey)
7. Simone Lackner

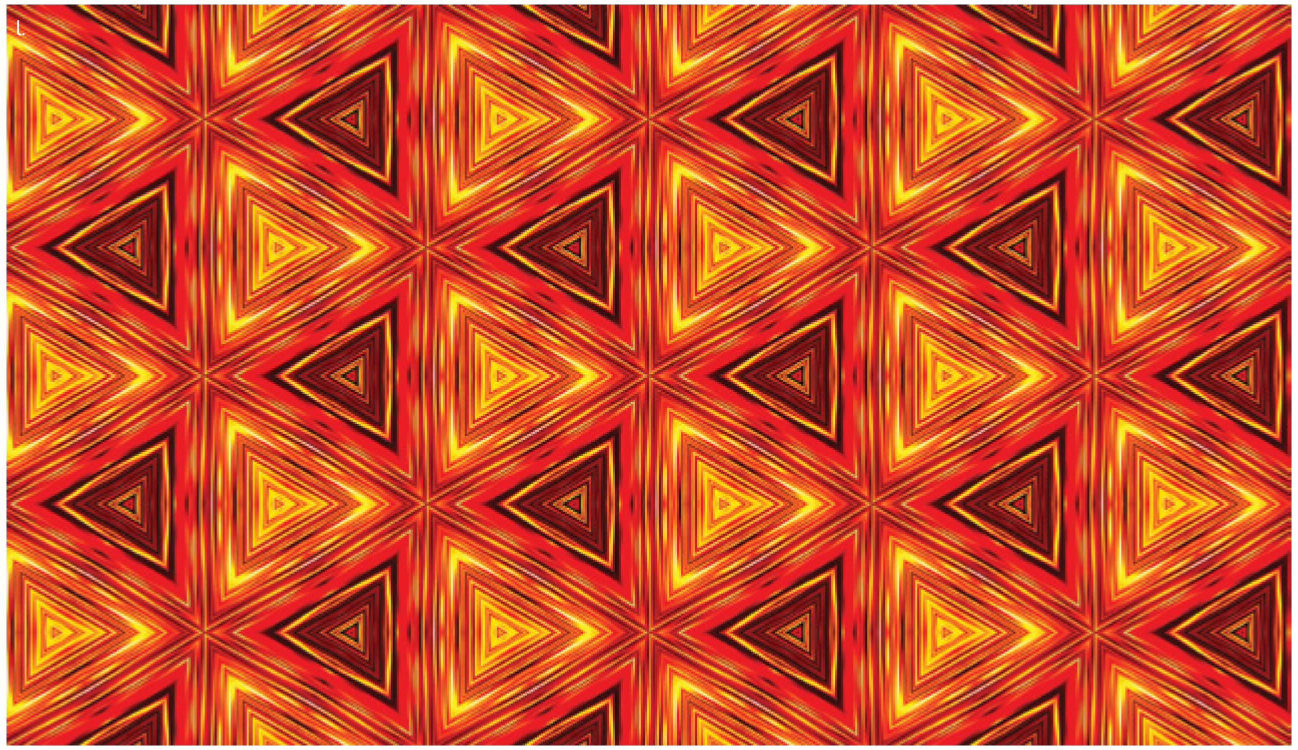
MASTER'S STUDENTS
8. Alexandre Laborde
9. Bernardo Esteves
10. Michelle de Goeij
11. Miguel Paço

RESEARCH TECHNICIANS
12. António Lucas Martins
13. Rita Esteves

INTERN
14. João Martins



Whole field motion direction selectivity observed in a genetically labeled population of neurons arranged bilaterally in the zebrafish brain. In this rendered view of a 3D 2-photon imaging volume, each direction selective voxel is color coded according to its preferred direction.



Principal Investigator
JOE PATON

LEARNING LAB

For our ancient ancestors learning was necessary for survival. Will these berries make me ill? Which bird-calls announce the approach of a tiger? Millennia have passed, but to be a successful, or at least an adequate human, we still need to learn about the world. Even trivial tasks such as calling the elevator require learning – making a mental connection between two events separate in time. How is the brain able to create these connections, which can happen either seconds, minutes, or even hours apart? Are there neural clocks ticking away somewhere inside our brains drawing invisible lines between cause and effect? And how does the brain generate the dynamic internal representations that underlie cognition?

Scientific Approach

The Learning lab studies how information about dynamic, internal variables can be encoded across networks of neurons. One of the lab's contributions to the field was the discovery that information about elapsed time can be encoded in a wave-like activity pattern that travels slowly across populations of neurons within a region called the striatum. An additional discovery made by the lab showed that subjective perception of time can be directly controlled by manipulating the activity of dopamine neurons within a brain structure called the substantia nigra in mice. The loss of these neurons is the major contributing factor to symptoms of Parkinson's Disease, a condition which is known to be associated with impaired timing capabilities in patients.

Other projects in the lab target the thalamus and frontal areas of the cortex. These frontal areas specifically are optimal sites for studying timing behaviour as they are thought to be involved in the association of experienced positive outcomes with the choices and actions that have led to them, or in other words, creating a mental connection between causes and positive effects. A deeper understanding of these areas could have far reaching implications for grasping how people function in both healthy and pathological conditions such as addiction or Parkinson's Disease.

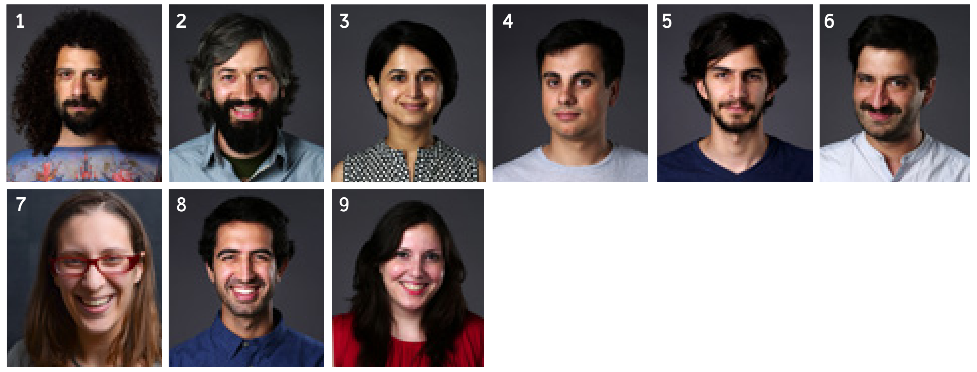
In 2017, Joseph Paton, the principal investigator of the Learning Lab was selected as a scholar by the prestigious Howard Hughes Medical Institute International Research Scholars Programme and was also awarded an ERC Consolidator grant. These funds will support the team's efforts to further dissect the mechanisms by which internally generated signals, such as the ones that inform the brain about the passage of time, are used to drive behaviour.

MAIN INTERESTS:
How the brain learns what to do and when to do it

METHODS:
Behaviour, Neurobiology, Molecular Biology, Mathematical Modelling

MODEL / AREA OF FOCUS:
Rodents / Basal Ganglia, Thalamus, Frontal Areas of the Cerebral Cortex

LEARNING LAB

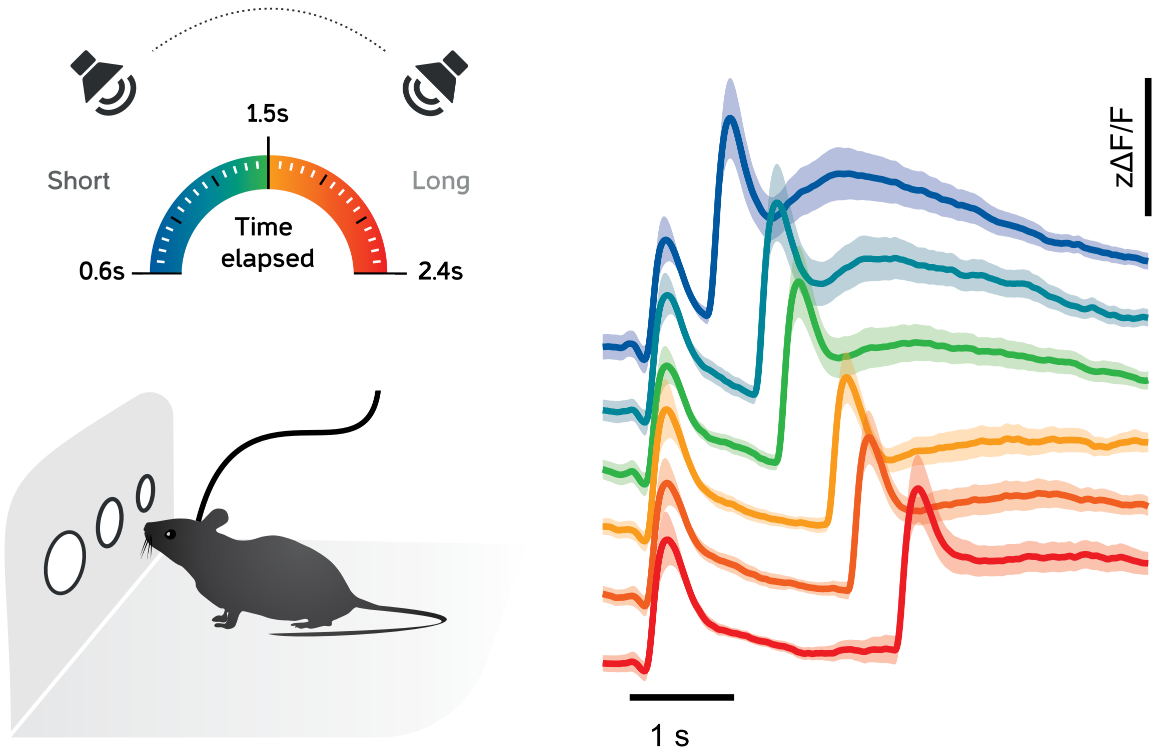


LAB MEMBERS

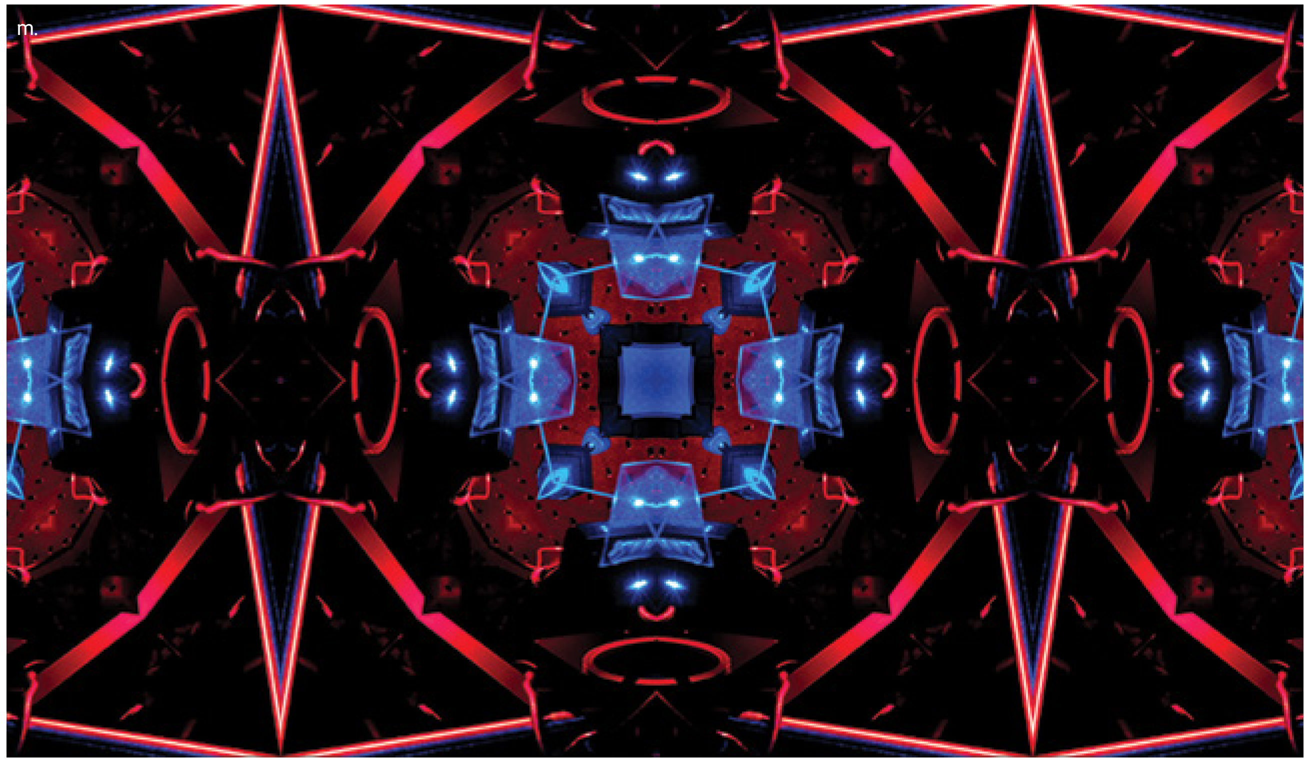
POSTDOCTORAL RESEARCHERS
1. Bassam Atallah
2. Tiago Monteiro

PHD STUDENTS
3. Asma Motiwala (Co-supervision with Christian Machens)
4. Bruno Cruz
5. Gonçalo Guiomar (Co-supervision with Christian Machens)
6. Mauricio Toro
7. Sofia Soares

RESEARCH TECHNICIANS
8. Filipe Rodrigues
9. Margarida Duarte



Fiber photometric recording of dopamine neurons responses in the substantia nigra pars compacta of mice performing an interval discrimination task. Activity is aligned on interval onset, cooler colours indicate shorter intervals, warmer colours indicate longer intervals (Adapted from Soares et al, 2016).



Principal Investigator

LEOPOLDO PETREANU

CORTICAL CIRCUITS LAB

Our brain is constantly interpreting the environment around us to plan and guide our actions. This requires combining often noisy and contradictory sensory inputs with internal models of the world. The Cortical Circuits lab studies how this process emerges from networks of neurons in the mouse brain. They focus on the neocortex, a seemingly simple sheet of neurons located at the outermost part of the brain, which is especially developed in humans and endows us with advanced cognitive abilities. The team uses the latest techniques to study how these areas interact to combine sensory stimuli with internal factors to give rise to perception.

Scientific Approach

The Cortical Circuits lab applies a structure-to-function approach to understand the neural basis of visual perception. Wiring diagrams and organising rules of neural circuits inspire and constrain mechanistic models of brain function. Using optical and electrophysiological techniques the researchers study the wiring logic of cortical circuits in areas that are required for visual perception in rodents. The team applies advanced optical methods to map the connectivity of axons that link distant areas of the neocortex with unprecedented detail. They also measure the activity of the same circuits in mice performing perceptual tasks using 2-photon imaging, high density microelectrode arrays and whole-cell recordings. This combined approach allows the researchers to understand both the computations implemented by cortical circuits as well as how they emerge from the underlying neuronal network. They are testing to what extent conserved circuits motifs perform similar computations across the neocortex and how sensory evidence and internal factors are combined to build a coherent model of the world.

MAIN INTERESTS:
How the brain builds a representation of the environment from sensory stimuli

METHODS:
Imaging, Electrophysiology, Behaviour

MODEL /AREA OF FOCUS:
Rodents / Visual Cortex

CORTICAL CIRCUITS LAB

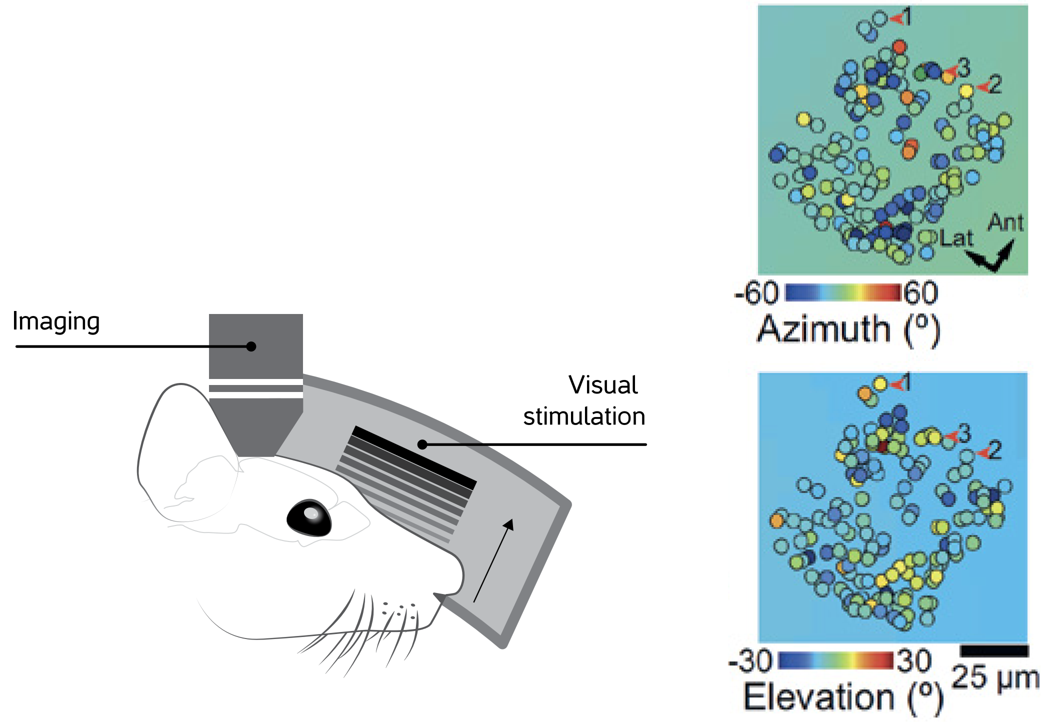
LAB MEMBERS

PHD STUDENTS

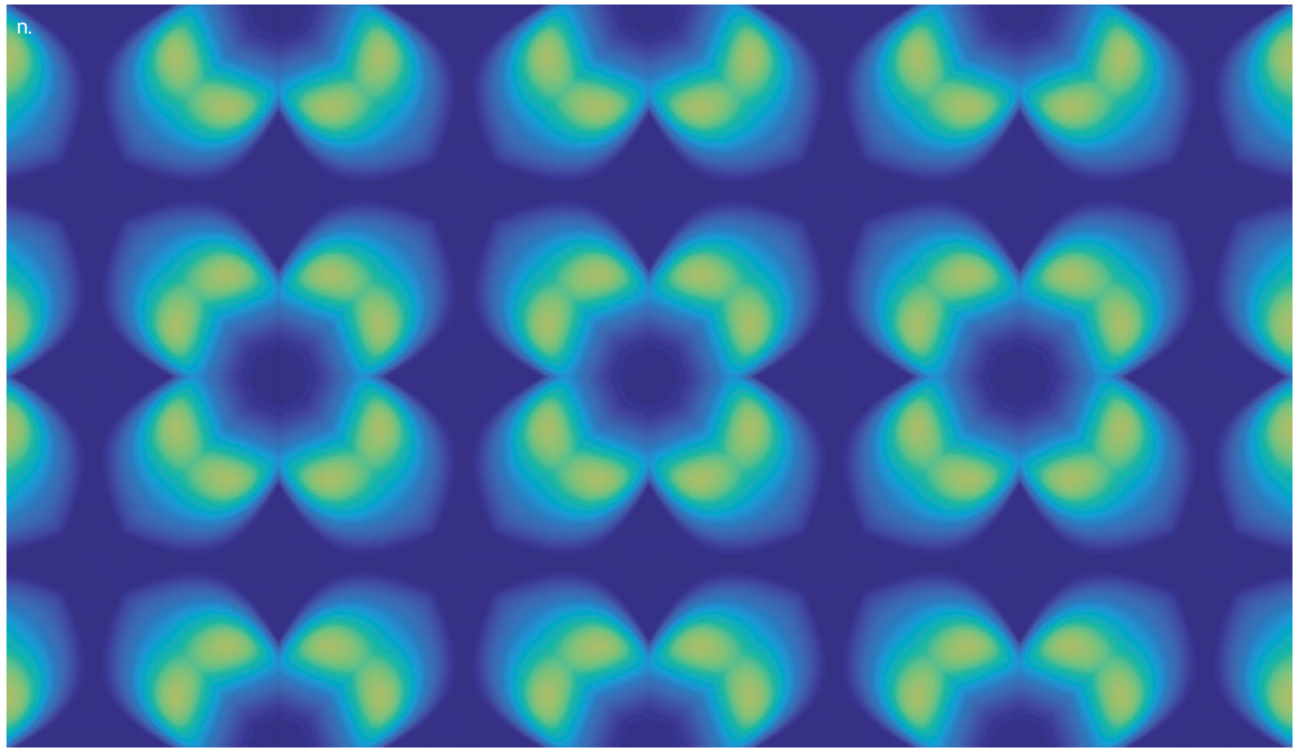
1. Gabriela Fioreze
2. Hedi Young
3. Marina Fridman
4. Rodrigo Dias
5. Tiago Marques
6. Radhika Rajan
7. Oihane Horno (Co-supervision with Christian Machens)

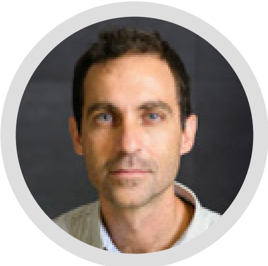
MASTER'S STUDENTS

8. Shane Beato



Map of the visual information relayed by cortical feedback connections to a point in visual cortex.





Principal Investigator
ALFONSO RENART

CIRCUIT DYNAMICS AND COMPUTATION LAB

Processes such as sensing, remembering, or deciding are computations accomplished through the exchange of nerve impulses by networks of neurons in the brain. Although the way in which single neurons use electrical activity to emit pulses is relatively well understood, neurons in the brain do not operate in isolation, and the trains of pulses from one neuron affect and are affected by the nerve impulses of the neurons with which it is connected. Since it is now possible to monitor the activity of hundreds of neurons simultaneously, it is becoming feasible to describe how neurons coordinate their activity in the living brain. Formulating general principles describing how neurons in key brain areas work together while animals solve specific tasks is an important step for understanding how the brain computes.

Scientific Approach

The goal of the Circuit Dynamics and Computation lab is to understand how the dynamics of networks of neurons allows them to solve particular problems. Although the team's ultimate objective is to understand neural computation at the circuit level in mathematical terms, they believe that, at the moment, the most effective approach to achieve this goal is to use a combined experimental-theoretical approach. This is because the available experimental evidence describing the activity of neuronal circuits during specific computations is too scarce to formulate accurate theories. The lab's approach is therefore to first design behavioural tasks for rats and mice that isolate a specific computation, second, to record the simultaneous activity of many neurons during performance of these tasks, and finally to use mathematical methods to analyse this data and to generate models of how these computations are implemented. Specifically, the team is studying a variety of problems, among which two central ones are the way in which sensory areas in the cerebral cortex represent auditory information and use it to make simple decisions, and the way in which associative areas in the prefrontal cortex mediate short-term memory, by guiding actions using sensory information no longer present in the environment. Some of this work is done in collaboration with the Theoretical Neuroscience Lab and with the Systems Neuroscience Lab.

MAIN INTERESTS:
Identifying generic principles governing the dynamics of cortical circuits and the way in which they produce function

METHODS:
Behaviour, Electrophysiology, Analysis, Theory

MODEL / AREA OF FOCUS:
Rodents, Human / Auditory Cortex, Prefrontal Cortex

CIRCUIT DYNAMICS AND COMPUTATION LAB

LAB MEMBERS

POSTDOCTORAL RESEARCHERS
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3. Tor Stensola

PHD STUDENTS
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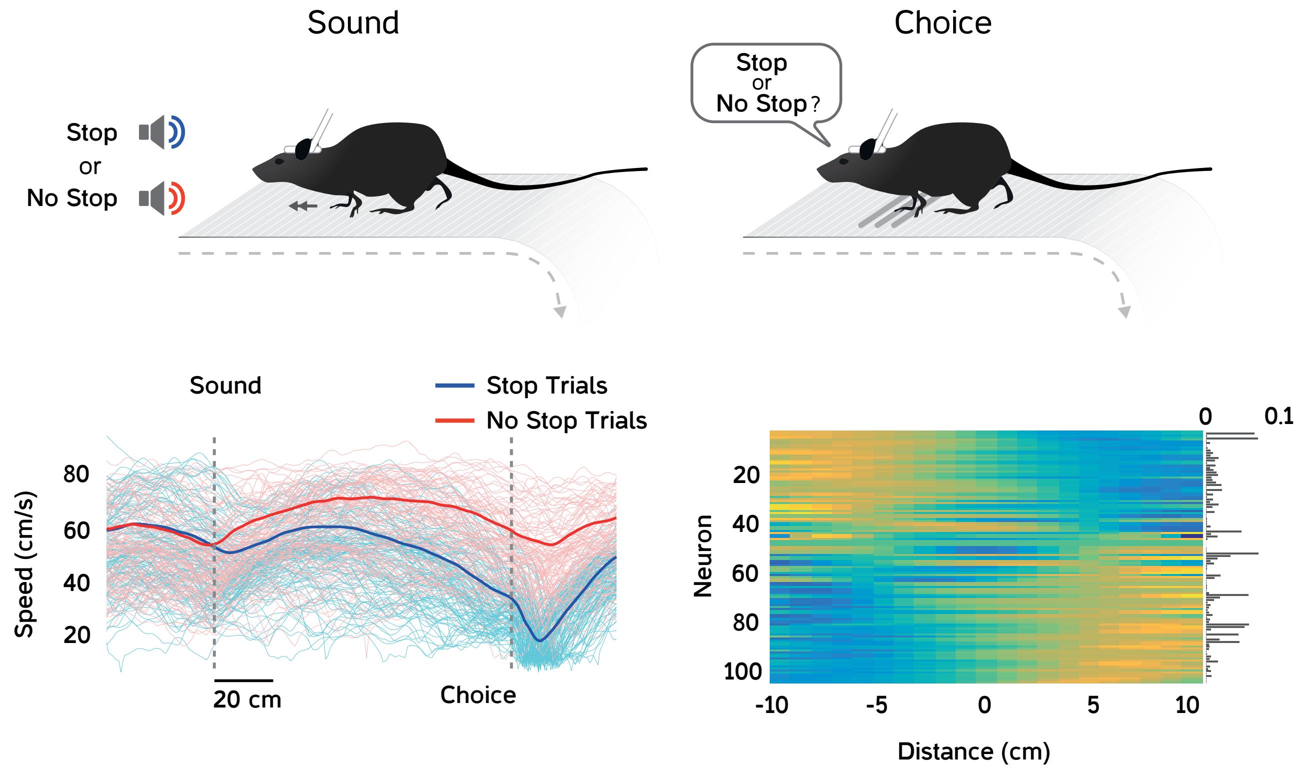
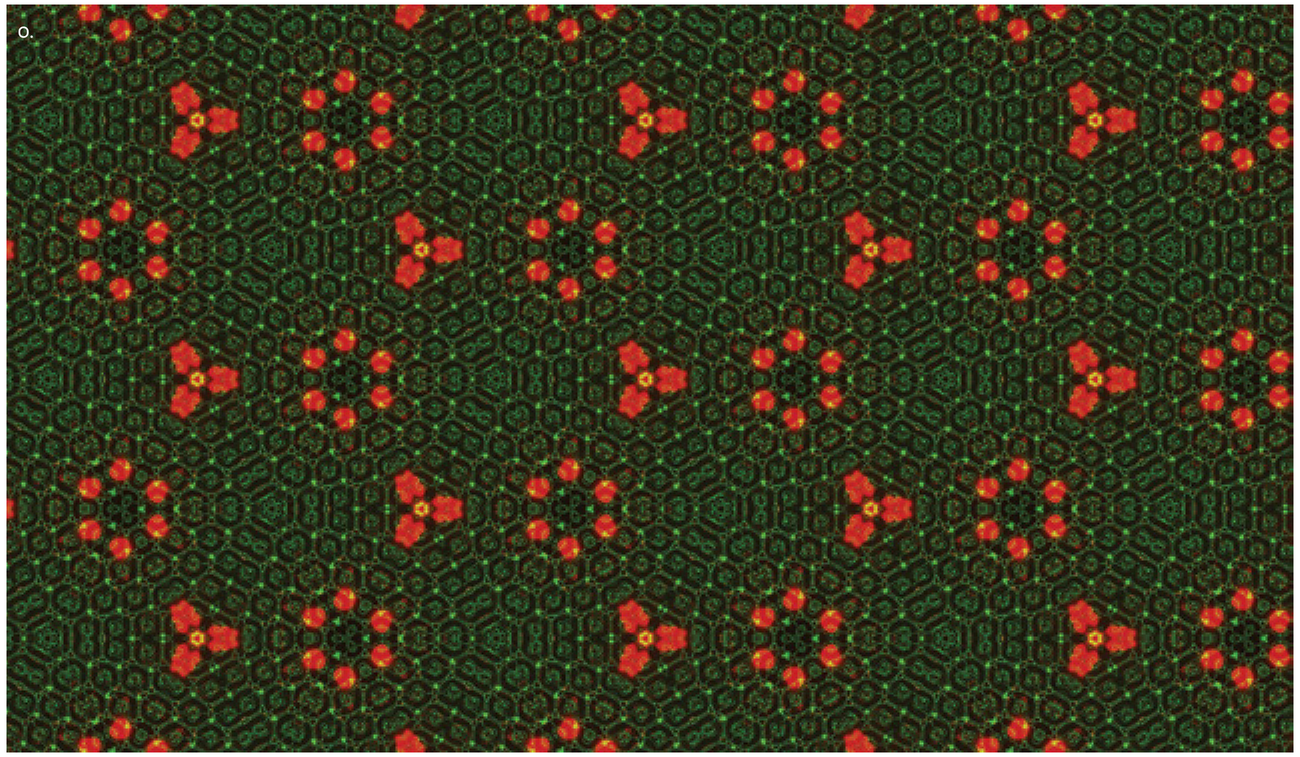
5. João Afonso
6. Raphael Steinfeld
7. Roberto Medina
8. Juan Castiñeiras

MASTER'S STUDENTS
9. André Pombeiro

RESEARCH TECHNICIANS
10. Mafalda Valente
11. André Monteiro
12. Margarida Duarte



The neural basis of delayed actions. (Top) Behaviour. Each trace is the instantaneous speed of a mouse traversing a treadmill. At a particular location either of two tones is played briefly. For one tone (blue) the mouse should stop running at a choice point down the treadmill. For the other tone (red) the mouse should not stop at the choice point. Thicker lines are average trajectories for the two types of trials. **(Bottom) Physiology.** We record the activity of multiple neurons simultaneously in the medial prefrontal cortex while the mice perform this task. Each row in the figure corresponds to one simultaneously recorded neuron. We use neural activity to predict the instantaneous speed of the mouse in each trial. The colour in each row shows the spatial distribution of the predictive power of a typical spike from each neuron. The population is divided into two groups. Increases in activity from one group of neurons (bottom rows) signal enhanced prediction for future mouse positions, whereas increases in activity from the other group (top rows) signal enhanced prediction for past locations. Few neurons signal prediction of current locations.



Principal Investigator
CHRISTA RHINER

STEM CELLS AND REGENERATION LAB

Loss of neurons in the adult brain can happen through injury and disease and may lead to devastating, often irreversible, results. An emerging field in biology aspires to reconstitute lost groups of neurons through the activation of stem cells, which exist in many body tissues including the brain. Repopulation of the damaged area by stem cells progenies is thought to hold the potential to promote recovery of lost function. At the same time, misregulated proliferation of stem cells may lead to tumour growth and metastasis. In order to both effectively utilise stem cells to fight the consequences of neuronal loss, and to prevent their misuse through cancer, researchers are now focusing on understanding the mechanisms that control stem cell activation and specialisation.

Scientific Approach

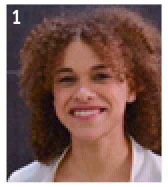
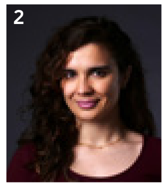
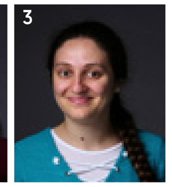
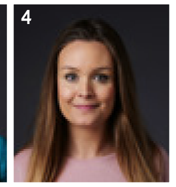
The Stem Cells and Regeneration lab is interested in isolating the factors that bring about activation of adult stem cells during tissue regeneration after injury or tumour formation. To that end, the team studies the molecular mechanisms through which neural stem cells are activated and produce new nerve cells in the adult brain. The methods utilised in the lab include genetics, RNA-sequencing, high-end confocal microscopy and behavioural assays to test recovery of neural function. The team applies these methods in the adult fruit fly brain, within a region called the optic lobe. Recent work from the lab has resulted in the discovery of damage-responsive stem cells in this area and the identification of several candidate genes that are thought to underlie this process. Currently, the team is characterising these genes while concurrently working on identifying other brain regions that are able to regenerate. Ultimately, the team's discoveries may lead to new therapies to facilitate tissue repair, such as brain regeneration after stroke, and preventing dysregulated stem cell proliferation that may lead to tumour formation.

MAIN INTERESTS:
how adult stem cells can switch from being dormant to actively dividing in situations relevant for tumor formation or tissue regeneration after injury

METHODS:
Genetics, RNA-sequencing, Confocal microscopy, Behavioural assays

MODEL /AREA OF FOCUS:
Fruit Flies / Entire brain

STEM CELLS AND REGENERATION LAB

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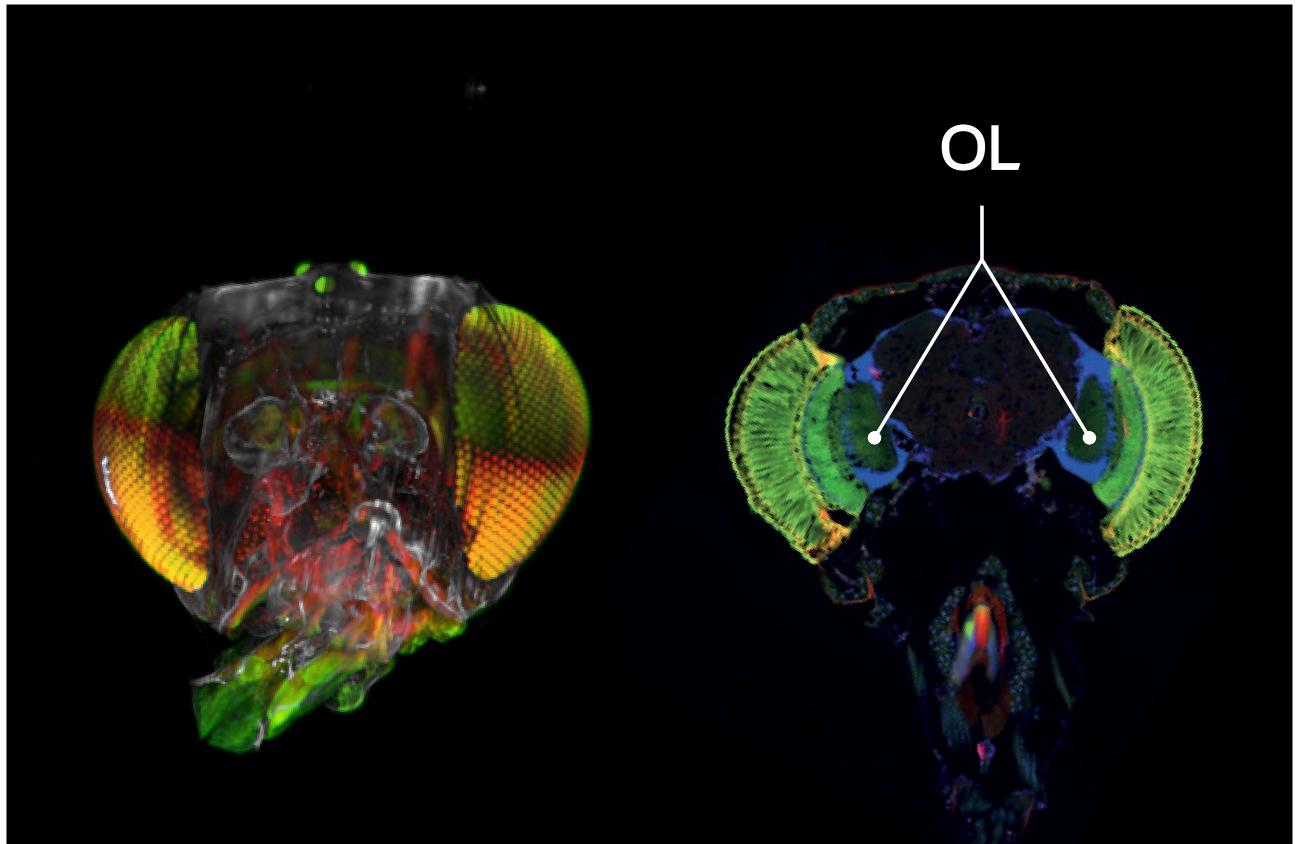
LAB MEMBERS

POSTDOCTORAL RESEARCHER
1. Silvia Schwartz

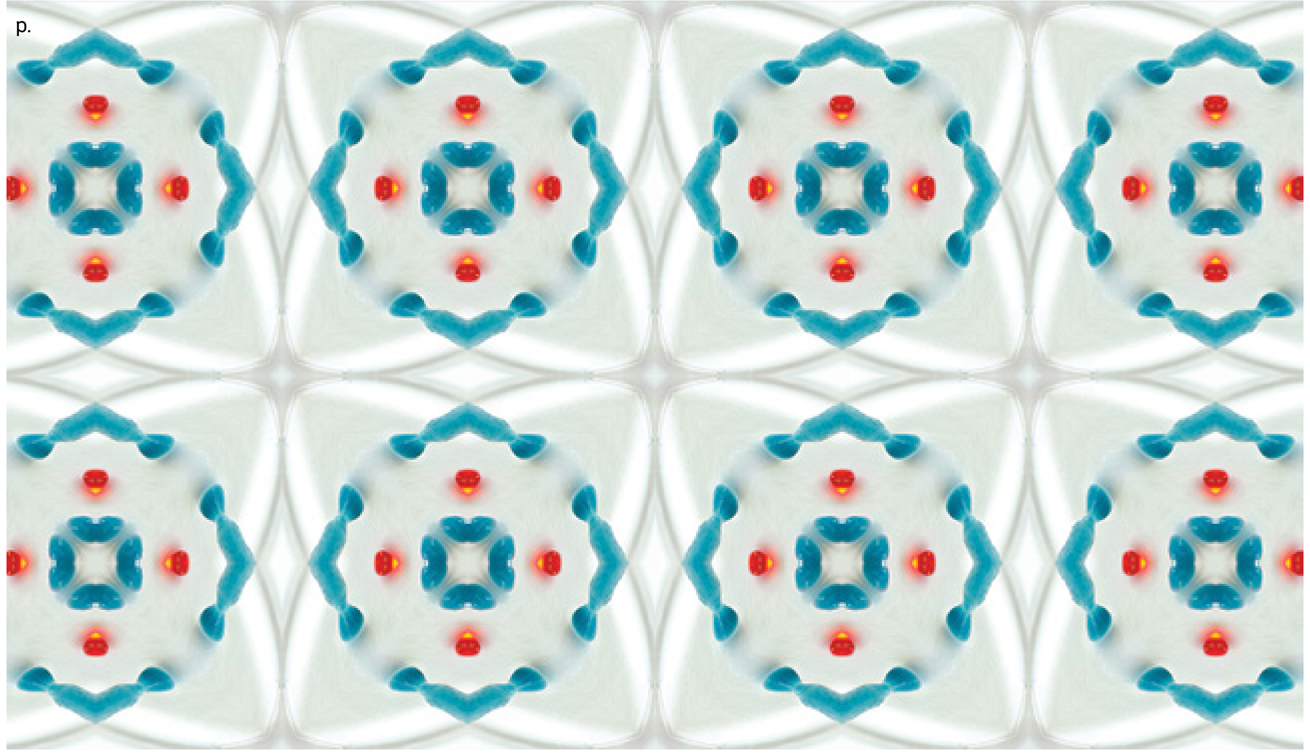
PHD STUDENT
2. Anabel Rodriguez Simões

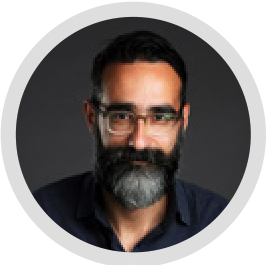
MASTER'S STUDENT
3. Carolina Alves

RESEARCH TECHNICIAN
4. Carmo Soares



Ultramicroscope image of a fruit fly head after traumatic brain injury (stab lesion targeting the optic lobes). The entry point of the stab lesion is marked in white on the right eye. Section: cross section of a *Drosophila* revealing the visual system and underlying brain. The optic lobes (OL) contain damage-responsive stem cells capable of producing new neurons upon injury.





Principal Investigator
CARLOS RIBEIRO

BEHAVIOUR AND METABOLISM LAB

The food we eat affects all aspects of our lives, including ageing, ability to reproduce, lifespan, mental state and mood. For better or worse, we are what we eat. Yet, how the brain controls food choice is still a mystery. What are the neural processes that drive us to choose a pretzel over an apple, or a steak over ice cream? To tap into this problem researchers have to tackle difficult questions such as how does the brain know which nutrients the body needs to stay healthy and how is this information translated into action?

Scientific Approach

The Behaviour and Metabolism lab addresses these questions using the fruit fly Drosophila melanogaster, one of the most powerful and versatile genetic animal models currently available. The fly allows the researchers to combine a wide array of tools and approaches, which include, genetic circuit manipulations, activity imaging, automated, quantitative methods for studying behaviour, microbiome manipulations, and tissue specific large scale RNAi screens. Team members use this wide array of approaches since it enables us to implement an integrative neuroscience approach, necessary to solve this whole-organism problem.

Recent advances in the lab include the publication of a research article identifying two species of bacteria that strongly impact the fly's dietary cravings. The team found that the presence of these bacteria in the animals' gut not only stopped them from developing an appetite for nutrients that were lacking from their diet, but also protected them from the consequences of the nutrients' absence. The researchers are currently working on characterising the mechanisms by which these microbes (which also exist in humans) could influence the functioning of the brain to control food-choice.

MAIN INTERESTS:
The neural mechanisms of nutrition

METHODS:
Optogenetics, Nutritional manipulations, Molecular and Biochemical methods, Neuroanatomy, Microbial manipulations of the host, Behaviour

MODEL /AREA OF FOCUS:
Fruit Flies / Whole Brain

BEHAVIOUR AND METABOLISM LAB

LAB MEMBERS

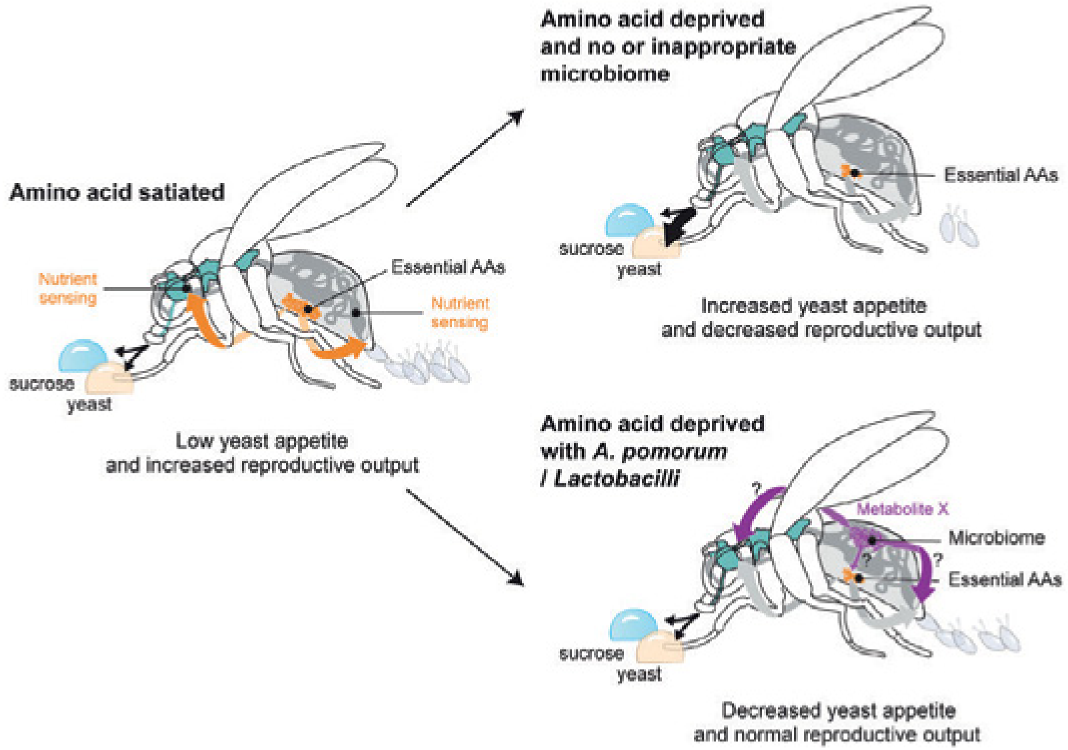
POSTDOCTORAL RESEARCHERS
1. Daniel Münch
2. Kathrin Steck
3. Pavel Itskov
4. Zita Santos

PHD STUDENTS
5. Dennis Goldschmidt
6. Patrícia Francisco
7. Samantha Herbert
8. Samuel Walker

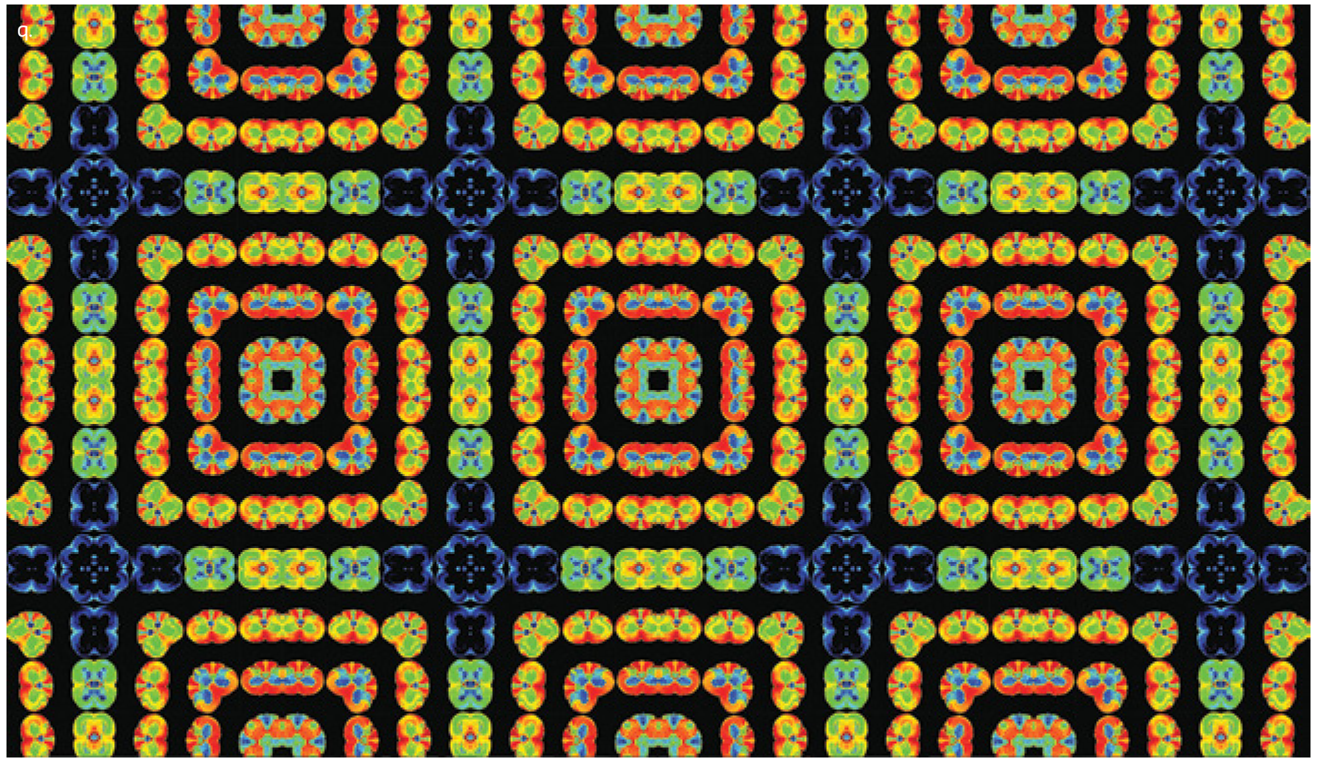
MASTER'S STUDENTS
9. Rita Figueiredo

RESEARCH TECHNICIANS
10. Margarida Anjos
11. Célia Baltazar

LAB MANAGER
12. Ana Paula Elias



Model of the impact of essential amino acids on food choice and reproduction, depending on the presence of the microbiota of the host. The nervous system is highlighted in turquoise, amino acids in orange, and commensal bacteria in purple. Arrow weight from the proboscis to the food drops indicate amount of feeding, and the number of eggs reflect the reproductive output. The orange and purple arrows indicate potential effects of essential amino acids and metabolites, respectively, at the level of the nervous and reproductive systems. Metabolite X refers to a hypothetical metabolite mimicking the presence of amino acids.



Principal Investigator
NOAM SHEMESH

NEUROPLASTICITY AND NEURAL ACTIVITY LAB

When the Greek Philosopher Heraclitus spoke about how change is central to the universe, coining the phrase "no one ever steps into the same river twice", one wonders if he could have foreseen the implications his words would have on the human brain. Throughout normal development, experience and learning, or injury and disease, our brain's activity and structure are always in motion. So much so that one can almost even say that no one ever records from the same brain twice. How do these different processes influence the brain's functionality and structure over time?

Scientific Approach

To find the "missing link" between behaviour and changes on the molecular, or cellular level, the Neuroplasticity and Neural Activity lab develops pioneering functional magnetic resonance imaging (fMRI) techniques. fMRI is a non-invasive, powerful tool for studying various neuroscience and biomedical questions. Current fMRI methods work by performing indirect measures of neural activity by following accompanying changes in blood volume and oxygenation level. However, changes in blood flow, in addition to being an indirect measure, occur over a timescale of seconds, while neural activity occurs within a fraction of a single second. This difference in timescale points out an obvious limitation of current fMRI techniques – they are too slow to resolve many important processes in the brain. To address these issues, the team's first steps, for which they have recently received support for from the European Research Council, have been focused on developing novel techniques that harness the power and versatility of MRI to perform direct measurements of neural activity on a much faster timescale. For instance, the team harnesses ultrahigh magnetic fields to image the dynamics of cell swellings (which are coupled with neural activity), as well as neurotransmitter release in the brain. These various measurements are performed in-vivo using state of the art 9.4T and 16.4T scanners, in both anesthetised and behaving rodents.

MAIN INTERESTS:
Direct functional MRI based on cell swellings and neurotransmitter release

METHODS:
Functional Magnetic Resonance Imaging (fMRI), Optogenetics, Behaviour

MODEL /AREA OF FOCUS:
Rodents / Whole brain

NEUROPLASTICITY AND NEURAL ACTIVITY LAB

LAB MEMBERS

RESEARCH ASSOCIATE
1. Andrada Ianus

POSTDOCTORAL RESEARCHERS
2. Cristina Chavarrías
3. Daniel Nunes
4. Ekaterina Vinnik
5. Julia Huntenburg
6. Rafael Henriques
7. Rui Simões
8. Tal Shemesh

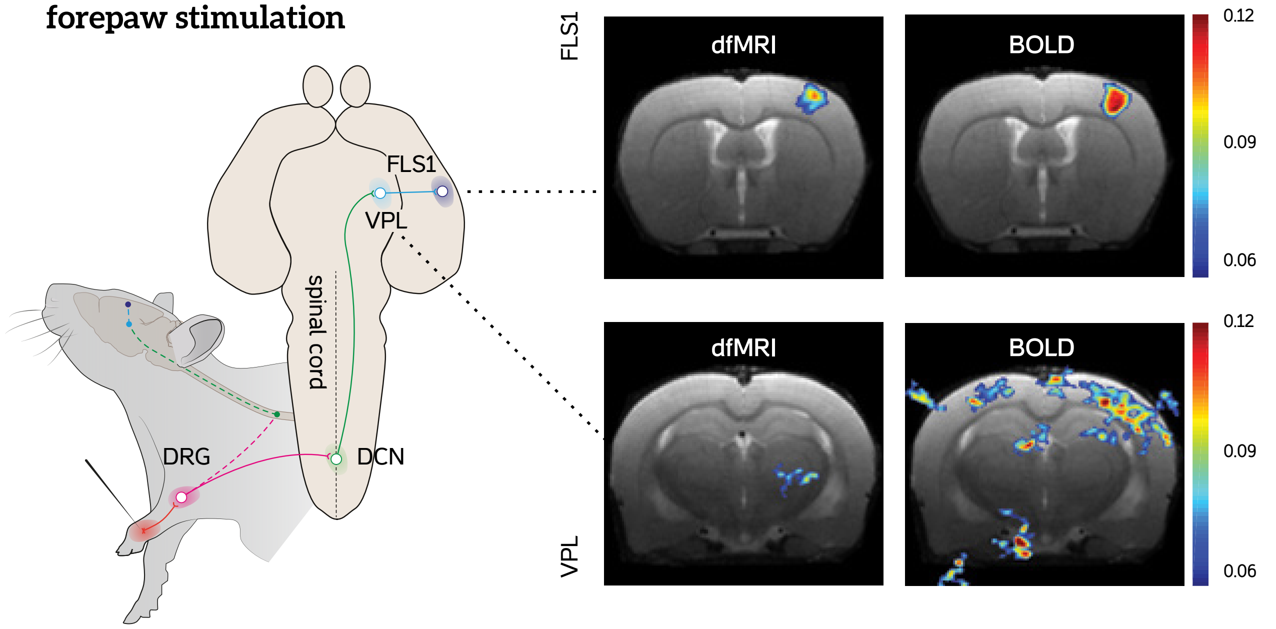
VISITING SCIENTISTS
9. Jelle Veraart
10. Sónia Gonçalves

PHD STUDENTS
11. Inês Santiago
12. Madalena Fonseca (co-supervised with Zachary Mainen)
13. Rita Gil
14. Teresa Serradas Duarte

MASTER'S STUDENTS
15. Francisca Fernandes

RESEARCH TECHNICIANS
16. Frederico Severo

Neural circuitry of the forepaw stimulation



Functional magnetic resonance imaging using measurements sensitive to diffusion of water molecules (dfMRI) is more sensitive to activated brain areas than the traditional functional methods used in functional imaging (BOLD). (Left) Schematic representation of the sensorial pathway of the forepaw. Upon stimulation, specific brain areas are activated. (Right) The signal recorded with dfMRI matches with the known anatomy of this circuitry, in comparison to the traditional BOLD contrast.

Principal Investigator
LUÍSA VASCONCELOS

INNATE BEHAVIOUR LAB

You are walking down the street with your stomach rumbling when you suddenly catch a whiff of a delicious smell. Without giving it a second thought you decide to follow it, making a few wrong turns until you find yourself in a nice bakery. This behaviour, common to humans and other animals, is called foraging, the active seeking of food. It is actually only one example of a group of behaviours defined as instinctive, or innate. These behaviours do not require learning, nor experience, they are often involuntary and can occur in individuals even without their awareness. Other well-known examples of innate behaviours include nest-building and courtship. Fortunately, unlike other behaviours such as decision-making, the neural circuits that underlie innate behaviours are hardwired, which means that they are invariant from animal to animal. This fact makes these behaviours an excellent case study in neuroscience, where the neural processes involved can be mapped out from sensory input to motor output.

Scientific Approach

To dig down into the neural circuitry of innate behaviour, the Innate Behaviour lab focuses on two main behaviours – the relatively simple avoidance of a repulsive odour and the more intricate courtship behaviour. Both behaviours are studied in the fruit fly *Drosophila melanogaster*, a powerful model system that offers a wide range of advanced techniques. These include genetic manipulations to help to identify which neurons are involved in specific behaviours, optogenetic tools to monitor the activity of neurons, and highly detailed video monitoring to establish the most precise relationship between behaviour and neural activity.

Using this combined approach, in a research article published in 2017, the team was able to establish a direct link between neural activity and behaviour, when they discovered a group of neurons (called apterous neurons) that have direct control over sexual receptivity in female flies. When the researchers silenced these particular neurons, females significantly reduced their receptivity towards males. In addition, they were able to pinpoint a specific behavioural hallmark that was affected - the walking pace of the female. Together, these results represent an important step towards gaining a better understanding of the neural mechanisms that control female receptivity. For the next step, the team is trying to pin down the neural circuitry these neurons tap into in order to find out how they exact this powerful effect on the behaviour of the female.

MAIN INTERESTS:
Identification of the neural circuits and mechanisms that control innate, or instinctive, behaviours

METHODS:
Optogenetics, Imaging, Behaviour, Genetics

MODEL /AREA OF FOCUS:
Fruit Flies / Whole Brain

INNATE BEHAVIOUR LAB

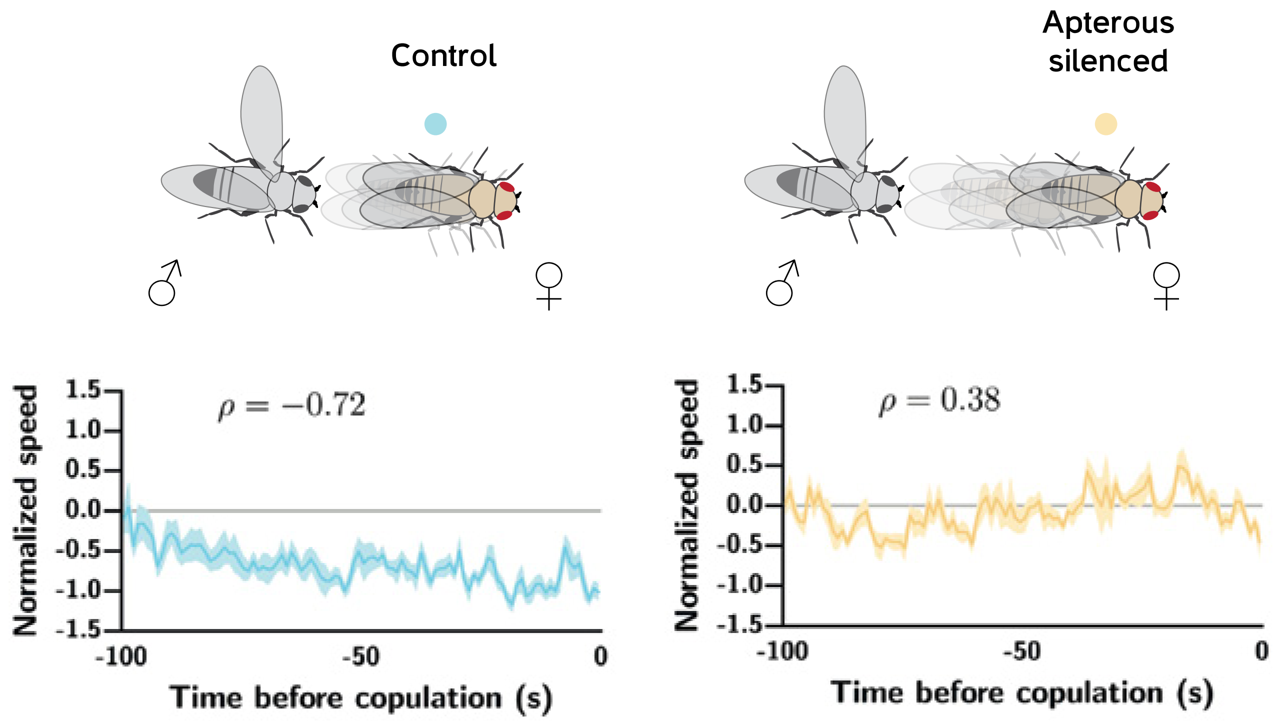
LAB MEMBERS

POSTDOCTORAL RESEARCHERS
1. Cecília Mezzera
2. Márcia Aranha
3. Nélia Varela (until June)

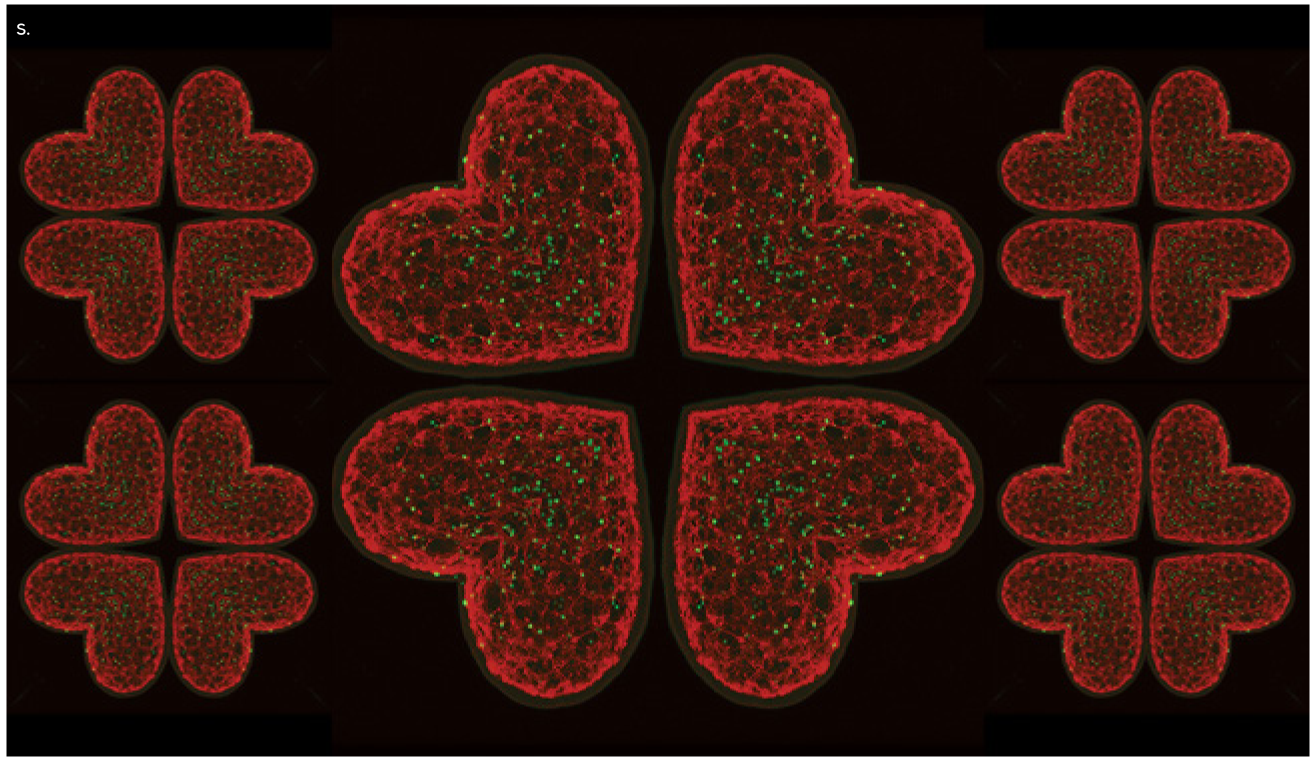
PHD STUDENTS
4. Cristina Ferreira
5. Eliane Ochôa Arez
6. Miguel Gaspar
7. Ricardo Zacarias (Co-supervision with Marta Moita)

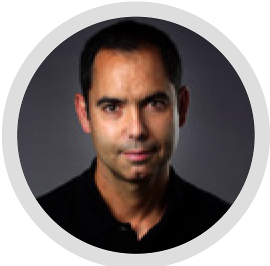
MASTERS STUDENT
8. Margarida Brotas

RESEARCH TECHNICIANS
9. Sophie Dias



Control females, in blue, gradually slow down before copulation while apterous-silenced females, in yellow, maintain the speed.





Principal Investigator

HENRIQUE VEIGA FERNANDES

IMMUNOPHYSIOLOGY

Despite common belief, the involvement of the immune system in health goes well beyond fighting harmful invaders. Our view of its roles has been continuously expanding to include other conditions such as degenerative diseases, obesity and cancer. Therefore, it is crucial to characterise its exact involvement in these and other health-related processes in order to assess how the immune system could be harnessed to promote health and wellbeing.

Scientific Approach

The Immunophysiology lab explores the role of cross-talk between neurons and the immune system in the prevention and resolution of disease. To that end, the team mainly focuses on mucosal barriers, such as the intestine and the lung. These organs are in permanent contact with the external environment and have a complex and dense network of neuronal and immune cells. This combination of features makes these organs an optimal site to reveal how the neural and immune systems work together to preserve health.

Using this approach, the lab has recently revealed a surprising role of the neural network that surrounds these organs: immune regulation. The team discovered that while the immune system is the one that actively fights infection, the neurons are the ones that are in charge of detecting the invasion and setting the immune response in motion. These findings may have a tremendous potential in the design of novel therapeutic approaches to disease as they pinpoint new selective targets that can be harnessed in allergy, inflammation, obesity and cancer.

MAIN INTERESTS:
The role of cross-talk between neurons of the peripheral nervous system and the immune system in the prevention and resolution of disease

METHODS:
Genetic, molecular and cellular approaches, flow cytometry, confocal microscopy and in vivo models of disease

MODEL /AREA OF FOCUS:
Rodents / Mucosal Barriers, such as the intestine and the lung

IMMUNOPHYSIOLOGY LAB

LAB MEMBERS

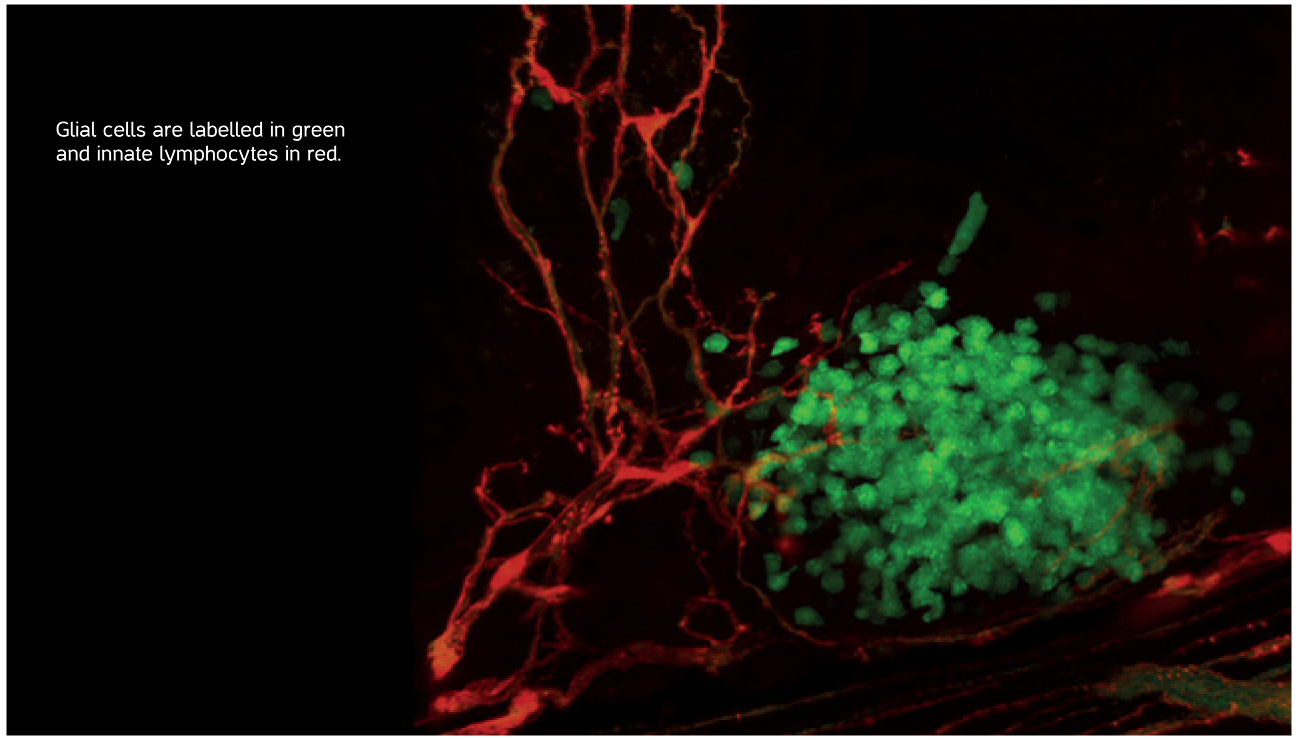
POSTDOCTORAL RESEARCHERS
1. Cristina Godinho da Silva
2. Julie Chesné
3. Manuela Ferreira

PHD STUDENTS
4. Ana Filipa Cardoso
5. Rita Domingues
6. Sílvia Madeira
7. Vânia Cardoso
8. Telmo Catarino

RESEARCH TECHNICIANS
9. Bruno Raposo
10. Miguel Rendas

VISITING STUDENT
11. Julia Riedlberger
12. Ana Sofia Borges

LAB MANAGER
13. Hélder Ribeiro



Glial cells are labelled in green and innate lymphocytes in red.

Research Associates List

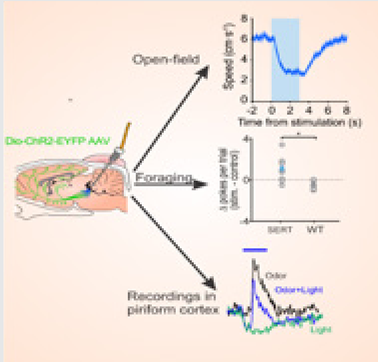
RESEARCH ASSOCIATES ARE SENIOR RESEARCHERS WHO MANAGE INDEPENDENT PROJECTS IN ASSOCIATION WITH PARTICULAR LABS AT CR.

5-HT and decision making

Research Associate:
Eran Lottem

Associated with:
Systems Neuroscience lab

Serotonin (5-HT) is a central neuromodulator implicated in the regulation of many processes and, and its dysregulation can contribute to altered perception as well as pathological conditions such as depression and obsessive-compulsive disorder. Using theory-driven experimental approaches, combined with electrophysiological, optical and genetic techniques in mice, Dr. Lottem's research explores 5-HT's function in decision-making and learning.



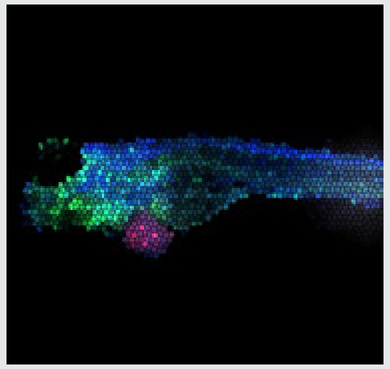
Cancer development and innate immune evasion

Research Associate:
Rita Fior

Team:
Vanda Póvoa (PhD Student)

Associated with:
Telomeres, Ageing and Cancer lab

Tumour cells employ mechanisms that circumvent the immune response. By doing so, tumours manage to grow and achieve further metastasis. Dr. Fior's research combines live imaging, genetic and chemical tools to study the process of innate immune evasion and intra-tumoural clonal interactions using the zebrafish-larvae xenograft model. Understanding the process of innate immune rejection/ evasion may lead to new avenues of anti-cancer therapies based on modulating conserved innate immune mechanisms.



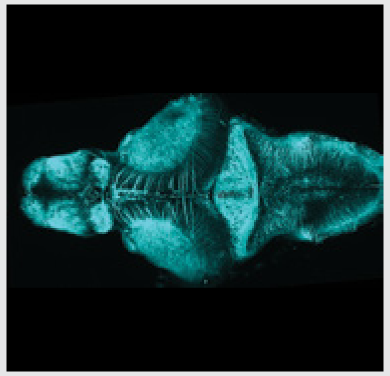
Development of neural circuits

Research Associate:
Ruth Diez del Corral

Team: Bernardo Esteves (Masters Student); João Martins (Masters Student)

Associated with: Vision to Action lab & Collective Behaviour lab

The nervous system is composed of a large variety of neuronal and glial cell types that connect to create functional functions, such as basic survival mechanisms (e.g. breathing) and behavioural responses to internal and external stimuli. The research of Dr. Diez del Corral focuses on understanding how neural circuits are formed during development by using the zebrafish larva as an animal model. Her team is particularly interested in imaging the formation of circuits within the whole brain.

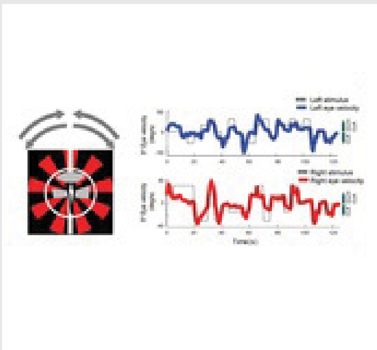


Neural circuits for visuomotor behaviour

Research Associate:
Claudia Feierstein

Associated with:
Vision to Action lab

How does our brain use information to select an appropriate behaviour Dr. Feierstein's research approaches the question by using custom-built microscopes and high-speed behavioural tracking to record neuronal activity in the entire brain of zebrafish larvae while closely monitoring their behaviour. By combining imaging, behavioural analysis, and manipulation of activity, she aims to understand the processing occurring in different brain areas and how they contribute to behaviour.



Adjunct Labs List

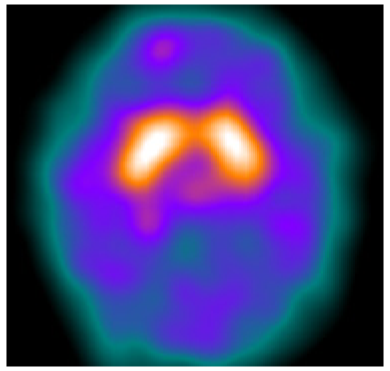
IN ADDITION TO THE 19 RESEARCH LABS, CR IS ALSO ASSOCIATED WITH ADJUNCT LABS, WHICH WORK IN AREAS COMPLEMENTARY TO CR LABS.

Inside the Champalimaud Centre for the Unknown

Neuropsychiatry

Principal investigator:
Albino Oliveira-Maia

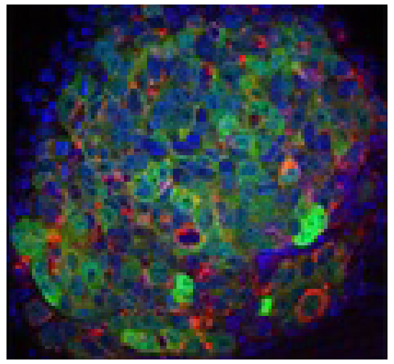
The Neuropsychiatry Unit started in 2013 as an interface between the Champalimaud Clinical Centre and the Champalimaud Neuroscience Programme. The team is dedicated to clinical care and translational research in mental and behavioural health, focusing on areas that are close to research interests in neuroscience under development at Champalimaud Research. At the Unit, psychiatrists and psychologists delivering care at the Clinical Centre work with other clinical and non-clinical researchers to deepen knowledge about neuropsychiatric disorders and their treatment.



Telomeres, Ageing and Cancer

Principal investigator:
Miguel Godinho-Ferreira

The Telomeres, Ageing and Cancer lab conducts basic and clinical research. On the basic level, the lab asks how the shortening of telomeres - structures that secure the end of chromosomes and protect them from deterioration - is involved in cancer. On the clinical level, the team is developing a method that will use zebrafish as "avatars" to determine the right type of chemotherapy for individual patients.



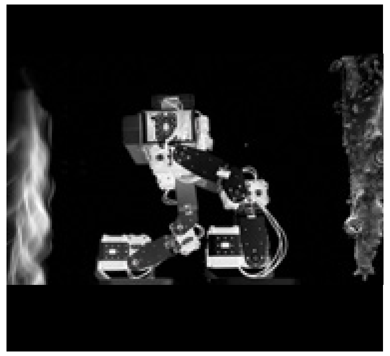
Outside the Champalimaud Centre for the Unknown

Intelligent Systems

Principal investigator:
Adam Kampff

Affiliation:
The Sainsbury Wellcome Centre, University College London

The Intelligent Systems lab studies intelligent systems. Their goal is to identify the general principles of brain function that support intelligent behaviour and to implement them in machines. Specifically, they focus on how the brain constructs a representation of the environment: How is this representation learned? How is it encoded in the activity of neural networks? How is it used to control adaptive behaviour?

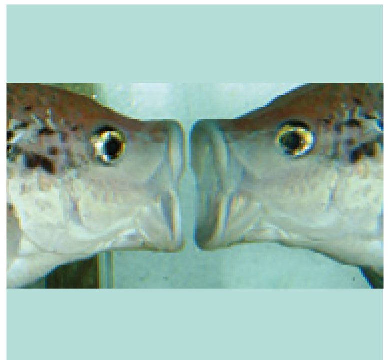


Social NeuroEndocrinology

Principal investigator:
Rui Oliveira

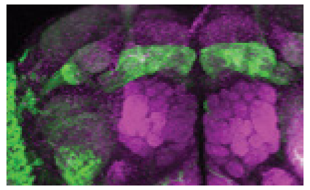
Affiliation:
Instituto Superior de Psicologia Aplicada (ISPA) & Instituto Gulbenkian de Ciência (IGC)

The main research interest of the Social NeuroEndocrinology 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). In particular the team is interested in understanding how brain and behaviour can be shaped by the social environment, and how the cognitive, neural and genetic mechanisms underlying plasticity in the expression of social behaviour have evolved.



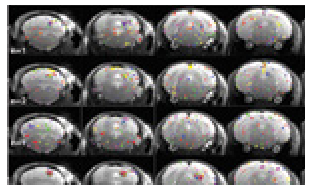
Publications Highlights

IN 2017, CR INVESTIGATORS PUBLISHED 53 RESEARCH ARTICLES. THESE PUBLICATIONS MIRROR THE EXPANDING SCOPE OF THE PROGRAMME, FEATURING NOVEL INSIGHTS IN DIVERSE FIELDS OF BIOLOGY.



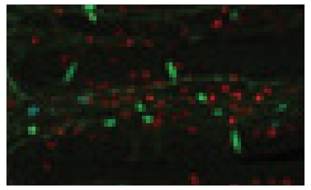
The "Desire Switch"

Scientists at the **Innate Behaviour lab** identified a "desire switch" in the brain of fruit flies: whenever the scientists would stop the activity of a particular group of neurons, called *apterous* neurons, females would no longer give males a chance to mate.[1]



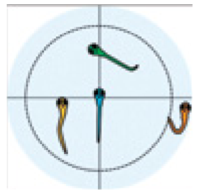
An unprecedented view of auditory processing

Scientists at the **Neuroplasticity and Neural Activity lab** designed a novel setup where high-field functional Magnetic Resonance Imaging was used to create the very first high-resolution map of neural activity across the entire mouse auditory pathway. [2]



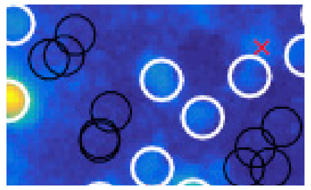
A "second brain" to fight disease

Who raises the alarm against harmful invaders that enter the body? Scientists at the **Immunophysiology lab** discovered that nerve cells in the gut and lungs detect signs of damaged tissue and the presence of invader organisms. Once detected, they produce chemical signals that set the immune response in motion. [3]



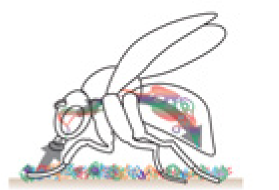
Simple rule explains formation of complex fish schools

By combining observation methods with mathematical modelling, scientists at the **Collective Behaviour lab** discovered that the emergence of complex swimming patterns can be explained with a surprisingly simple rule: each fish chooses which other fish to follow at random! [4]



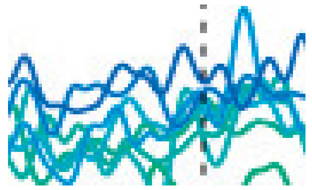
A neural map of movement

Using a miniature mobile microscope, scientists at the **Neurobiology of Action lab** were able to uncover a neural map in the brain that contains all possible movements that an animal can perform. [5]



Microbial mind control

Scientists at the **Behaviour and Metabolism lab** discovered two types of gut bacteria that "speak" with the brain to control a key aspect of behaviour: food choice. So next time you look at a menu, ask yourself: "is this what I want to eat, or is it what my microbes make me eat?" [6]



Ready - Set - ...?

Deciding when to take an action can be as important as deciding what action to take. Scientists at the **System Neuroscience lab** discovered that the exact moment of the execution of an action is the result of the combination of a predictable and unpredictable components that are processed by different brain regions. [7]

Why do parents risk themselves to protect their young?

Scientists at the **Behavioural Neuroscience lab** discovered that the answer is the so-called "love hormone" oxytocin. They found that the presence of oxytocin in the brain of mothers determined whether they chose to protect their young, or themselves. [8]

Publications

Afonso C, Paixao VB, Klaus A, Lunghi M, Piro F, Emiliani C, di Cristina M, Costa RM. Toxoplasma-induced changes in host risk behaviour are independent of parasite-derived AaaH2 tyrosine hydroxylase . Sci Rep 10.1038/s41598-017-13229-y.

Alden K, Timmis J, Andrews PS, Veiga-Fernandes H, Coles MC. Extending and Applying Spartan to Perform Temporal Sensitivity Analyses for Predicting Changes in Influential Biological Pathways in Computational Models . IEEE-ACM Trans. Comput. Biol. Bioinform. 10.1109/TCBB.2016.2527654.

Alvarez GA, Shemesh N, Frydman L. Internal gradient distributions: A susceptibility-derived tensor delivering morphologies by magnetic resonance . Sci Rep 10.1038/s41598-017-03277-9.

[1] *Aranha MM, Herrmann D, Cachitas H, Neto-Silva RM, Dias S, Vasconcelos ML. apterous Brain Neurons Control Receptivity to Male Courtship in Drosophila Melanogaster Females . Sci Rep 10.1038/srep46242.*

Athalye VR, Ganguly K, Costa RM, Carmena JM. Emergence of Coordinated Neural Dynamics Underlies Neuroprosthetic Learning and Skillful Control . Neuron 10.1016/j.neuron.2017.01.016.

[2] *Blazquez Freches G, Chavarrias C, Shemesh N. BOLD-fMRI in the mouse auditory pathway. Neuroimage. doi: 10.1016/j.neuroimage.2017.*

Burgess CP, Lak A, Steinmetz NA, Zatka-Haas P, Reddy CB, Jacobs EAK, Linden JF, Paton JJ, Ranson A, Schroder S, Soares S, Wells MJ, Wool LE, Harris KD, Carandini M. High-Yield Methods for Accurate Two-Alternative Visual Psychophysics in Head-Fixed Mice . Cell Reports 10.1016/j.celrep.2017.08.047.

Burgess CP, Lak A, Steinmetz NA, Zatka-Haas P, Bai Reddy C, Jacobs EAK, Linden JF, Paton JJ, Ranson A, Schröder S, Soares S, Wells MJ, Wool LE, Harris KD, Carandini M. High-Yield Methods for Accurate Two-Alternative Visual Psychophysics in Head-Fixed Mice. Cell Rep. 2017 Sep 5;20(10):2513-2524.

Busse L, Cardin JA, Chiappe ME, Halassa MM, McGinley MJ, Yamashita T, Saleem AB. Sensation during Active Behaviours . J. Neurosci. 10.1523/JNEUROSCI.1828-17.2017.

Cardoso SD, Faustino AI, Costa SS, Valerio F, Goncalves D, Oliveira RF. Social network predicts loss of fertilizations in nesting males of a fish with alternative reproductive tactics. Acta Ethol. 10.1007/s10211-016-0249-9.

[3] *Cardoso V, Chesne J, Ribeiro H, Garcia-Cassani B, Carvalho T, Bouchery T, Shah K, Barbosa-Morais NL, Harris N, Veiga-Fernandes H. Neuronal regulation of type 2 innate lymphoid cells via neuromedin U . Nature 10.1038/nature23469.*

Carvalho-Santos, Z, Ribeiro, C. Gonadal ecdysone titers are modulated by protein availability but do not impact protein appetite. Journal of Insect Physiology.

Clement RJG, Vicente-Page J, Mann RP, Ward AJW, Kurvers RHJM, Ramnarine IW, de Polavieja GG, Krause J. Collective decision making in guppies: a cross-population comparison study in the wild. Behav. Ecol. 10.1093/beheco/arx056.

Correia PA, Lottem E, Banerjee D, Machado AS, Carey MR, Mainen ZF. Transient inhibition and long-term facilitation of locomotion by phasic optogenetic activation of serotonin neurons . eLife 10.7554/eLife.20975.

Faustino AI, Tacao-Monteiro A, Oliveira RF. Mechanisms of social buffering of fear in zebrafish. Sci Rep 10.1038/srep44329.

Fick RHJ, Sepasian N, Pizzolato M, Ianus A, Deriche R. Assessing the Feasibility of Estimating Axon Diameter using Diffusion Models and Machine Learning.

Fior R, Povoa V, Mendes RV, Carvalho T, Gomes A, Figueiredo N, Ferreira MG. Single-cell functional and chemosensitive profiling of combinatorial colorectal therapy in zebrafish xenografts . Proc. Natl. Acad. Sci. U. S. A. 10.1073/pnas.1618389114.

Fujiwara T, Cruz TL, Bohnslav JP, Chiappe ME. A faithful internal representation of walking movements in the Drosophila visual system . Nat. Neurosci. 10.1038/nn.4435.

Gezelius H, Moreno-Juan V, Mezzera C, Thakurela S, Rodriguez-Malmierca LM, Pistolic J, Benes V, Tiwari VK, Lopez-Bendito G. Genetic Labeling of Nuclei-Specific Thalamocortical Neurons Reveals Putative Sensory-Modality Specific Genes . Cereb. Cortex 10.1093/cercor/bhw290.

Ghani MU, Mesadi F, Kanik SD, Argunsah AO, Hobbiss AF, Israely I, Unay D, Tasdizen T, Cetin M. Dendritic spine classification using shape and appearance features based on two-photon microscopy . J. Neurosci. Methods 10.1016/j.jneumeth.2016.12.006.

Goldschmidt D, Manoonpong P, Dasgupta S. A Neurocomputational Model of Goal-Directed Navigation in Insect-Inspired Artificial Agents . Front. Neurorobotics 10.3389/fnbot.2017.00020.

Grabska-Barwinska A, Barthelme S, Beck J, Mainen ZF, Pouget A, Latham PE. A probabilistic approach to demixing odors . Nat. Neurosci. 10.1038/nn.4444.

Hansen B, Khan AR, Shemesh N, Lund TE, Sangill R, Eskildsen SF, Ostergaard L, Jespersen SN. White matter biomarkers from fast protocols using axially symmetric diffusion kurtosis imaging . NMR Biomed. 10.1002/nbm.3741.

Heras FJH, Laughlin SB. Optimizing the use of a sensor resource for opponent polarization coding . PeerJ 10.7717/peerj.2772.

[4] *Hinz RC, de Polavieja GG. Ontogeny of collective behaviour reveals a simple attraction rule . Proc. Natl. Acad. Sci. U. S. A. 10.1073/pnas.1616926114.*

Ianus A, Shemesh N, Alexander DC, Drobnjak I. Double oscillating diffusion encoding and sensitivity to microscopic anisotropy . Magn. Reson. Med. 10.1002/mrm.26393.

Ianus A, Shemesh N. Incomplete initial nutation diffusion imaging: An ultrafast, single-scan approach for diffusion mapping. doi: 10.1002/mrm.26894.

Jespersen SN, Olesen JL, Hansen B, Shemesh N. Diffusion time dependence of microstructural parameters in fixed spinal cord. doi: 10.1016/j.neuroimage.2017.08.039.

Juusola M, Dau A, Song ZY, Solanki N, Rien D, Jaciuch D, Dongre S, Blanchard F, de Polavieja GG, Hardie RC. Microsaccadic sampling of moving image information provides Drosophila hyperacute vision. eLife 10.7554/eLife.26117.

[5] *Klaus A, Martins GJ, Paixao VB, Zhou PC, Paninski L, Costa RM. The Spatiotemporal Organisation of the Striatum Encodes Action Space . Neuron. 10.1016/j.neuron.2017.08.015.*

Laan A, de Sagredo RG, de Polavieja GG. Signatures of optimal control in pairs of schooling zebrafish . Proc. R. Soc. B-Biol. Sci. 10.1098/rspb.2017.0224.

Lak A, Nomoto K, Keramati M, Sakagami M, Kepecs A. Midbrain Dopamine Neurons Signal Belief in Choice Accuracy during a Perceptual Decision . Curr. Biol. 10.1016/j.cub.2017.02.026.

[6] *Leitao-Goncalves R, Carvalho-Santos Z, Francisco AP, Fioreze GT, Anjos M, Baltazar C, Elias AP, Itskov PM, Piper MDW, Ribeiro C. Commensal bacteria and essential amino acids control food choice behaviour and reproduction . PLoS. Biol. 10.1371/journal.pbio.2000862.*

Lenschow C, Sigl-Glockner J, Brecht M. Development of rat female genital cortex and control of female puberty by sexual touch . PLoS. Biol. 10.1371/journal.pbio.2001283.

Lopez-Beltran A, Paner G, Blanca A, Montironi R, Tsuzuki T, Nagashima Y, Chuang SS, Win KT, Madruga L, Raspollini MR, Cheng L. Lymphoepithelioma-like carcinoma of the upper urinary tract . Virchows Arch. 10.1007/s00428-017-2117-z.

Lu RW, Sun WZ, Liang YJ, Kerlin A, Bierfeld J, Seelig JD, Wilson DE, Scholl B, Mohar B, Tanimoto M, Koyama M, Fitzpatrick D, Orger MB, Ji N. Video-rate volumetric functional imaging of the brain at synaptic resolution . Nat. Neurosci. 10.1038/nn.4516.

Madeira N, Oliveira RF. Long-Term Social Recognition Memory in Zebrafish . Zebrafish 10.1089/zeb.2017.1430.

Melo FR, Bressan RB, Costa-Silva B, Trentin AG. Effects of Folic Acid and Homocysteine on the Morphogenesis of Mouse Cephalic Neural Crest Cells In Vitro . Cell. Mol. Neurobiol. 10.1007/s10571-016-0383-y.

Publications

Moreno-Juan V, Filipchuk A, Anton-Bolanos N, Mezzera C, Gezelius H, Andres B, Rodriguez-Malmierca L, Susin R, Schaad O, Iwasato T, Schule R, Rutlin M, Nelson S, Ducret S, Valdeolmillos M, Rijli FM, Lopez-Bendito G. Prenatal thalamic waves regulate cortical area size prior to sensory processing . Nat. Commun. 10.1038/ncomms14172.

Mowel WK, McCright SJ, Kotzin JJ, Collet MA, Uyar A, Chen X, DeLaney A, Spencer SP, Virtue AT, Yang EJ, Villarino A, Kurachi M, Dunagin MC, Pritchard GH, Stein J, Hughes C, Fonseca-Pereira D, Veiga-Fernandes H, Raj A, Kambayashi T, Brodsky IE, O'Shea JJ, Wherry EJ, Goff LA, Rinn JL, Williams A, Flavell RA, Henao-Mejia J. Group 1 Innate Lymphoid Cell Lineage Identity Is Determined by a cis-Regulatory Element Marked by a Long Non-coding RNA . Immunity 10.1016/j.immuni.2017.08.012.

Munch D, Galizia CG. Take time: odor coding capacity across sensory neurons increases over time in Drosophila . J. Comp. Physiol. A -Neuroethol. Sens. Neural Behav. Physiol. 10.1007/s00359-017-1209-1.

[7] *Murakami M, Shteingart H, Loewenstein Y, Mainen ZF. Distinct Sources of Deterministic and Stochastic Components of Action Timing Decisions in Rodent Frontal Cortex . Neuron 10.1016/j.neuron.2017.04.040.*

Nunes D, Cruz TL, Jespersen SN, Shemesh N. Mapping axonal density and average diameter using non-monotonic time-dependent gradient-echo MRI . J. Magn. Reson. 10.1016/j.jmr.2017.02.017.

Palombo M, Shemesh N, Ronen I, Valette J. Insights into brain microstructure from in vivo DW-MRSI. Neuroimage. doi: 10.1016/j.neuroimage.2017.11.028.

Peinado H, Zhang HY, Matei IR, Costa-Silva B, Hoshino A, Rodrigues G, Psaila B, Kaplan RN, Bromberg JF, Kang YB, Bissell MJ, Cox TR, Giaccia AJ, Erler JT, Hiratsuka S, Ghajar CM, Lyden D. Pre-metastatic niches: organ-specific homes for metastases . Nat. Rev. Cancer 10.1038/nrc.2017.6.

Perez-Escudero A, de Polavieja GG. Adversity magnifies the importance of social information in decision-making . J. R. Soc. Interface 10.1098/rsif.2017.0748.

Piper MDW, Soultoukis GA, Blanc E, Mesaros A, Herbert SL, Juricic P, He XL, Atanassov I, Salmonowicz H, Yang MY, Simpson SJ, Ribeiro C, Partridge L. Matching Dietary Amino Acid Balance to the In Silico-Translated Exome Optimizes Growth and Reproduction without Cost to Lifespan . Cell Metab. 10.1016/j.cmet.2017.02.005.

Ribeiro A, Monteiro JF, Certal AC, Cristovao AM, Saude L. Foxj1a is expressed in ependymal precursors, controls central canal position and is activated in new ependymal cells during regeneration in zebrafish . Open Biol 10.1098/rsob.170139.

[8] *Rickenbacher E, Perry RE, Sullivan RM, Moita MA. Freezing suppression by oxytocin in central amygdala allows alternate defensive behaviours and mother-pup interactions . eLife 10.7554/eLife.24080.*

Roleira A, Oliveira GA, Lopes JS, Oliveira RF. Audience Effects in Territorial Defense of Male Cichlid Fish Are Associated with Differential Patterns of Activation of the Brain Social Decision-Making Network . Front. Behav. Neurosci. 10.3389/fnbeh.2017.00105.

Rosenberg JT, Shemesh N, Muniz JA, Dumez JN, Frydman L, Grant SC. Transverse relaxation of selectively excited metabolites in stroke at 21.1T . Magn. Reson. Med. 10.1002/mrm.26132.

Saez RA, Saez A, Paton JJ, Lau B, Salzman CD. Distinct Roles for the Amygdala and Orbitofrontal Cortex in Representing the Relative Amount of Expected Reward . Neuron 10.1016/j.neuron.2017.06.012.

Saez RA, Saez A, Paton JJ, Lau B, Salzman CD. Distinct Roles for the Amygdala and Orbitofrontal Cortex in Representing the Relative Amount of Expected Reward. Neuron. 2017 Jul 5;95(1):70-77.e3.

Shemesh N, Rosenberg JT, Dumez JN, Grant SC, Frydman L. Distinguishing neuronal from astrocytic subcellular microstructures using in vivo Double Diffusion Encoded H-1 MRS at 21.1 T . PLoS One 10.1371/journal.pone.0185232.

Symvoulidis P, Lauri A, Stefanoiu A, Cappetta M, Schneider S, Jia HB, Stelzl A, Koch M, Perez CC, Myklatun A, Renninger S, Chmyrov A, Lasser T, Wurst W, Ntziachristos V, Westmeyer GG. NeuBtracker-imaging neurobehavioural dynamics in freely behaving fish . Nat. Methods 10.1038/NMETH.4459.

Vergara RC, Toro M. Conserved: inherited beyond genes . Estud. Psicol. 10.1080/02109395.2016.1268395.

Zhang ZY, Shemesh N, Frydman L. Efficient spectroscopic imaging by an optimized encoding of pretargeted resonances . Magn. Reson. Med. 10.1002/mrm.26161.

REVIEW ARTICLES

Diez Del Corral R, Morales AV. The Multiple Roles of FGF Signaling in the Developing Spinal Cord. Front Cell Dev Biol. 5:58.

Kolling N, Akam T. (Reinforcement?) Learning to forage optimally . Curr. Opin. Neurobiol. 10.1016/j.conb.2017.08.008.

Laan A, Madirolas G, de Polavieja GG. Rescuing Collective Wisdom when the Average Group Opinion Is Wrong . Front. Robot. AI 10.3389/frobt.2017.00056.

Lau B, Monteiro T, Paton JJ. The many worlds hypothesis of dopamine prediction error: implications of a parallel circuit architecture in the basal ganglia. Curr Opin Neurobiol. 2017 Oct;46:241-247.

Orger MB, de Polavieja GG. Zebrafish Behaviour: Opportunities and Challenges . Annu. Rev. Neurosci. 10.1146/annurev-neuro-071714-033857.

Simoes AR, Rhiner C. A Cold-Blooded View on Adult Neurogenesis . Front. Neurosci. 10.3389/fnins.2017.00327.

Veiga-Fernandes H, Freitas AA. The S(c) ensory Immune System Theory . Trends Immunol. 10.1016/j.it.2017.02.007.

Veiga-Fernandes H, Pachnis V. Neuroimmune regulation during intestinal development and homeostasis . Nat. Immunol. 10.1038/ni.3634.

*Walker, SJ, Goldschmidt, D, Ribeiro, C Craving for the future: the brain as a nutritional prediction system. Current Opinion in Insect Science, Global change biology * Molecular physiology 23, 96–103.*

BOOK CHAPTERS

Carey MR. Funding and career advancement in an Open Science environment. Chapter in Europe's Future: Open Science, Open Innovation and Open to the World. European Commission.

Fujiwara T, Chiappe E. Motor-driven modulation in visual neural circuits. Chapter 10 in Decoding neural circuit structure and function: cellular dissection using genetic model organisms. Vol. 261. Ed Mathias Wernet and Arzu Çelik. Springer Int.

EDITORIAL MATERIAL

Fairhall A, Machens C. Editorial overview: Computational neuroscience. Curr. Opin. Neurobiol. 10.1016/j.conb.2017.09.009.

Louis M, de Polavieja G. CollectiveBehaviour: Social Digging in Drosophila Larvae . Curr. Biol. 10.1016/j.cub.2017.08.023.

Manohar SG, Akam T. Cortical areas needed for choosing actions based on desires . Brain 10.1093/brain/awx119.

*Piper, M, Ribeiro, C. Editorial overview: Molecular physiology: Insect nutrition beyond energy. Current Opinion in Insect Science, Global change biology * Molecular physiology 23, viii–x.*

PATENTS

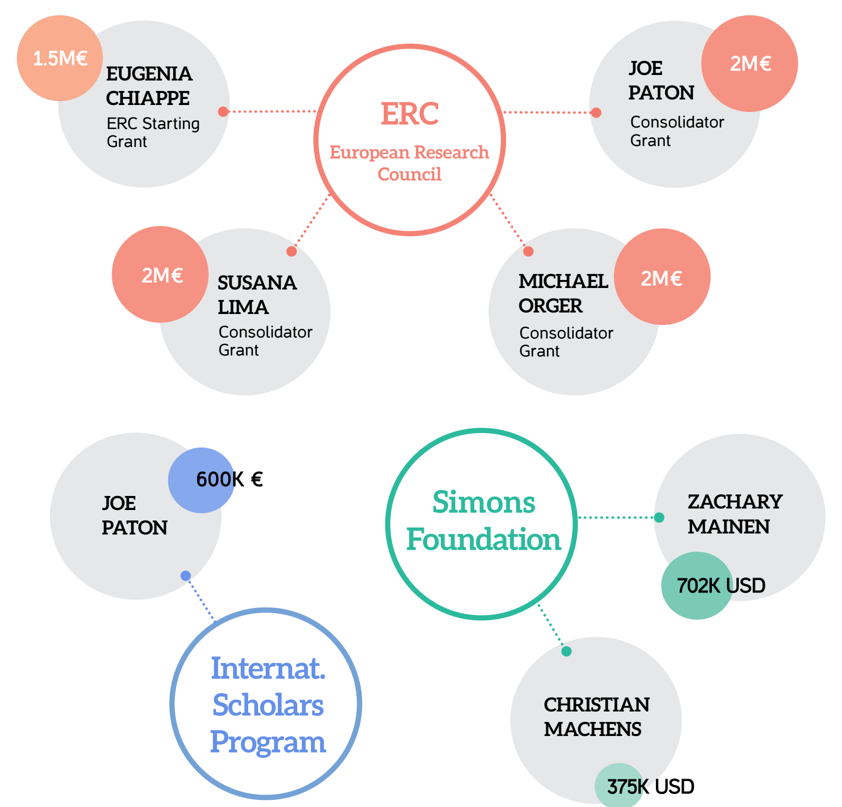
Loureiro N, Paixão VB, Costa RM, Santos F. System and method for operant learning brain machine interface. WO2017009787 A1. January 19, 2017.

External Funding
Highlights

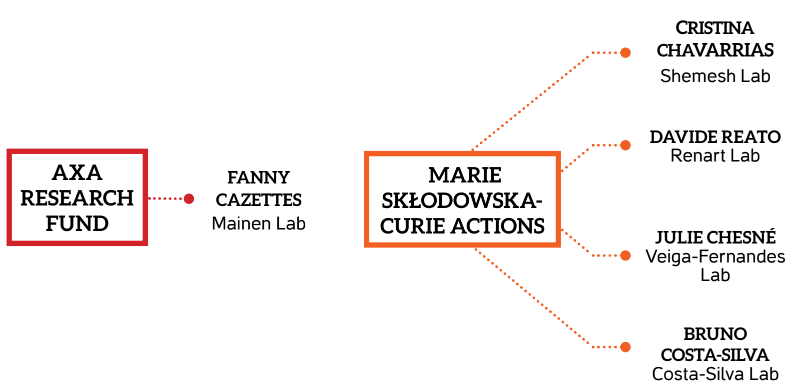
SINCE THE ESTABLISHMENT OF THE RESEARCH PROGRAMME AT CHAMPALIMAUD IN 2007, ITS RESEARCHERS HAVE BEEN AWARDED A SUM OF OVER 35 MILLION EUROS IN SUPPORT OF THEIR WORK.

2017 HAS BEEN AN EXCEPTIONAL YEAR, WITH SEVERAL PRESTIGIOUS AWARDS, GRANTS AND FELLOWSHIPS AWARDED TO CHAMPALIMAUD RESEARCH SCIENTISTS.

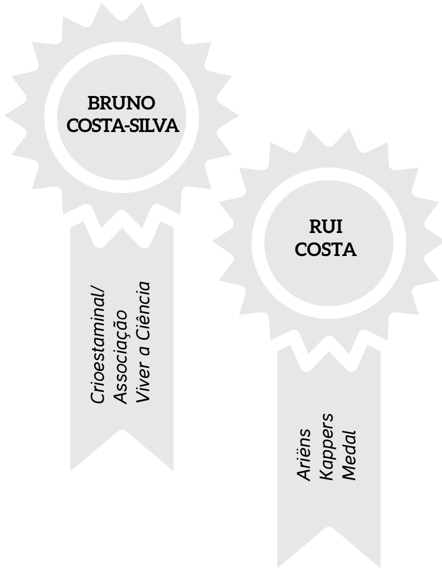
GRANTS



FELLOWSHIPS

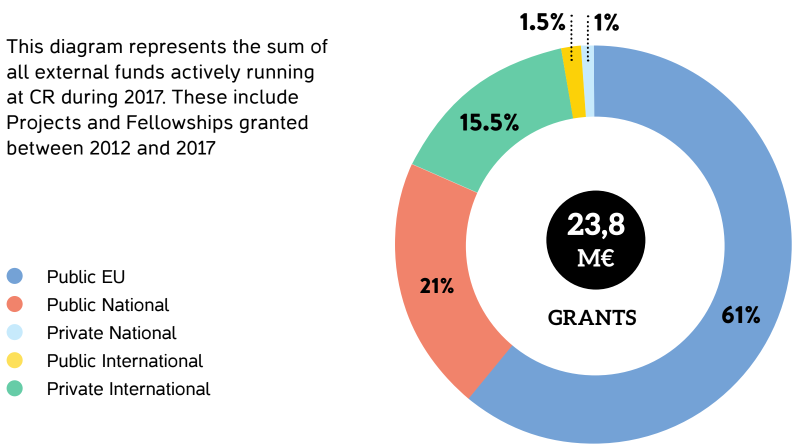


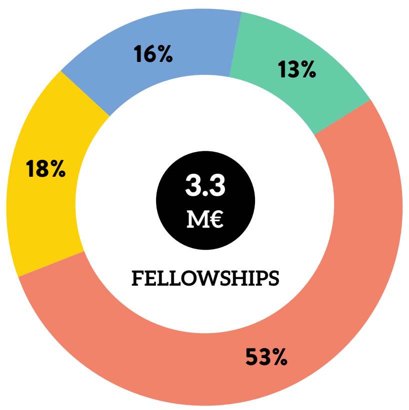
AWARDS



EXTERNAL FUNDING: FELLOWSHIPS & GRANTS ACTIVE IN 2017

This diagram represents the sum of all external funds actively running at CR during 2017. These include Projects and Fellowships granted between 2012 and 2017





List of external funds announced / started in 2017

AWARDS

Rui Costa – *Ariëns Kappers Medal – 2017 Pfizer Award*

Bruno Costa-Silva – *Prémio Crioestaminal/ Associação Viver a Ciência em Investigação Biomédica*

Tiago Monteiro – *Prémio ISPA de Investigação em Psicologia e Ciências do Comportamento*

GRANTS

BIAL Foundation

Joe Paton – *How do dopamine neurons and striatal populations interact during decision-making? (started 2017)*

Carlos Ribeiro – *Harnessing the power of closed-loop neuronal control to identify the circuit basis of decision making (started 2017)*

Breast Cancer Now

Bruno Costa Silva – *Bosutinib effects in pre-metastatic niche formation and lung metastasis in breast cancer. Catalyst Grant (Started 2017)*

European Research Council

Eugenia Chiappe – *Circuit mechanisms for self-movement estimation during walking. ERC Starting Grant (Started 2017)*

Susana Lima – *Hypothalamic circuits for the selection of defensive and mating behaviour in females. ERC Consolidator Grant (Awarded 2017)*

Michael Orger – *Whole-brain circuits controlling visuomotor behaviour. ERC Consolidator Grant (Awarded 2017)*

Joe Paton – *Basal ganglia circuit mechanisms underlying dynamic cognitive behaviour. ERC Consolidator Grant (Awarded 2017)*

Henrique Veiga-Fernandes – *Neuroimmune activation as a novel therapeutic approach for IBD. ERC-POC (Started 2017)*

European Molecular Biology Organisation (EMBO)

Bruno Costa-Silva – *The association of Exosome populations with liver metastasis. EMBO Installation Grant (Awarded 2017)*

FCT - Fundação para a Ciência e a Tecnologia

Manuela Ferreira *(Henrique Veiga-Fernandes Lab) – Role of diet-derived retinoids in natural intraepithelial lymphocytes and intestinal defence. FCT-Exploratory Grant (Started 2017)*

FERRING RESEARCH INSTITUTE INC

Henrique Veiga-Fernandes – *Activation of type 3 Innate Lymphoid Cells and innate IL-22 secretion via RET signaling for Inflammatory Bowel Disease treatment. (Awarded 2017)*

Horizon 2020 - Marie Skłodowska-Curie Innovative Training Networks

Bruno Costa-Silva – *European Liquid Biopsies Academy – Towards widespread clinical application of blood-based diagnostic tools. Programme Call (Awarded 2017)*

nternational Scholars Program

This programme is sponsored by the Howard Hughes Medical Institute, the Wellcome Trust, the Bill and Melinda Gates Foundation & the Calouste Gulbenkian Foundation

Joe Paton – *Toward a circuit level understanding of cognition (started 2017)*

Kavli Foundation

Carlos Ribeiro – *The microbial basis of feeding decisions (Started 2017)*

Simons Foundation

Christian Machens –*Communication between neural populations: circuits, coding, and behavior. Life Sciences-Simons Collaboration on the Global Brain Research Award (Started 2017)*

Zachary Mainen – *International Brain Laboratory (IBL). Life Sciences-Simons Collaboration on the Global Brain Research Award. (Started 2017)*

CCDR-LVT (FEDER) and FCT (PIDDAC)

Champalimaud Research – *Infrastructural Projects: Consortium for Genetically Tractable Organisms (CONGENTO). Portuguese Platform of BioImage (PPBI); Portuguese Biological Data Network (BioData.pt). (Started 2017)*

FELLOWSHIPS

AXA Research Fund

Fanny Cazettes *(Mainen Lab) – Neural Representations Of Policy Uncertainty Underlying Adaptive Behavior. AXA Postdoctoral sponsorship (Started 2017)*

Brain and Behaviour Research Foundation

Romain Ligneul *(Mainen Lab) – From neuronal firing to behaviour: breaking down the 5-HT chain of events. 2017 NARSAD Young Investigator Grant (Announced 2017)*

Deutsche Forschungsgemeinschaft

Daniel Münch *(Ribeiro Lab) – The neuronal basis of amino acid sensing in Drosophila melanogaster. Research Fellowship (Started 2017)*

H2020 - Marie Skłodowska-Curie actions

Cristina Chavarrias *(Shemesh Lab) –Neuronal MRI: Harnessing chemical exchange between N-Acetylaspartate and water for functional imaging of neural activity. (Started 2017)*

Davide Reato *(Renart Lab) – Role of neuronal spontaneous activity for sensory processing. (Awarded 2017)*

Julie Chesné *(Veiga-Fernandes Lab) – Impact of Neuromedin U in type 2 immunity and mucosal defence. (Started 2017)*

Bruno Costa-Silva – *Phenotypic characterization of Liver-derived exosomes populations associated with liver metastasis in pancreatic cancers. (Started 2017)*

European Molecular Biology Organisation (EMBO)

Constanze Lenschow – *Anatomical and functional characterisation of the neural circuits controlling ejaculation and the post-ejaculatory refractory period. EMBO Long-Term Fellowship (Awarded 2017)*

FCT - Fundação para a Ciência e a Tecnologia

INDP Class of 2016 (Ana Gonçalves, Andres Laan, Gonçalo Guiomar, Juan Castiñeiras, Oihane Horno, Radhika Rajan, Rita Gil, Tiago Costa). Doctoral Fellowship (Started 2017)

Anabel Rodriguez *(Rhiner Lab) – Molecular Mechanisms of Neural Stem Cell Activation following Brain Injury in Drosophila melanogaster. Doctoral Fellowship (Started 2017)*

Ana Carolina Marques *(Costa-Silva Lab) – Nanobiosensing platform based on MIP-SERS for breast cancer exosome characterisation and detection. Doctoral Fellowship (Started 2017)*

Dario Sarra *(Mainen Lab) – Serotonin modulation circuitry of patience and impulsivity. Doctoral Fellowship (Awarded 2017)*

Davide Reato *(Renart Lab) – Role of neuronal spontaneous activity for sensory processing. Postdoctoral Fellowship (Started 2017)*

Hugo Marques *(Carey Lab) – The nature of error signals in locomotor learning. Postdoctoral Fellowship (Started 2017)*

Marcelo Sousa *(Costa Lab) – Substantia Nigra pars compacta in Parkinson's Disease: function and vulnerability. Doctoral Fellowship (Started 2017)*

Teresa Serradas-Duarte *(Noam Shemesh Lab) – Imaging the neuronal reorganisation in a sensitive period of heightened plasticity. Doctoral Fellowship (Started 2017)*

Filipe Rodrigues *(Paton Lab) – Disentangling cognitive & movement parameters in interval timing. Doctoral Fellowship (Awarded 2017)*

Matheus Farias *(Moita Lab) – On the mechanisms by which descending neurons control defensive behaviours of fruit flies. Doctoral Fellowship (Awarded 2017)*

Maria Bettencourt *(Moreno Lab) – The role of cell fitness in tumour progression and metastasis formation. Doctoral Fellowship (Awarded 2017)*

Miguel Rendas *(Veiga-Fernandes Lab) – Regulation of innate lymphoid cells by circadian cues. Doctoral Fellowship (Awarded 2017)*

Lucas Martins *(Orger Lab) – Light-sheet imaging of functional networks underlying optic-flow processing in the zebrafish brain. Doctoral Fellowship (Awarded 2017)*

Nuno Rito *(Chiappe Lab) – Neural bases of a visually guided orientation behaviour in Drosophila melanogaster. Doctoral Fellowship (Awarded 2017)*

Cristina Godinho-Silva *(Veiga-Fernandes Lab) – Control of innate lymphoid cells by circadian clock signals. Postdoctoral Fellowship (Started 2017)*

CONTRACT-BASED RESEARCH

Pharmis

Bruno Costa-Silva – *a-eHSP90: Anticorpo para tratamento de cancros metastáticos (Started 2017)*

Roche

Joe Paton – *Pharmacological and circuit dissection of direct and indirect pathways during impulsivity. (Started 2017)*

Education Highlights

SINCE THE BEGINNING, THE CR HAS REGARDED EDUCATING FUTURE SCIENTISTS AS ONE OF ITS MAIN OBJECTIVES.

TO THIS END, THE CR HAS BEEN DEDICATING CONSIDERABLE EFFORTS TO THE DEVELOPMENT AND IMPLEMENTATION OF OUTSTANDING EDUCATIONAL PROGRAMMES, ADVANCED COURSES AND WORKSHOPS. AMONG THESE, THE TWO MAIN ENDEAVOURS OF THE EDUCATION EFFORT THE INTERNATIONAL NEUROSCIENCE DOCTORAL PROGRAMME AND THE CAJAL ADVANCED TRAINING COURSES.

INDP
International Neuroscience Doctoral Programme

Director: Joe Paton

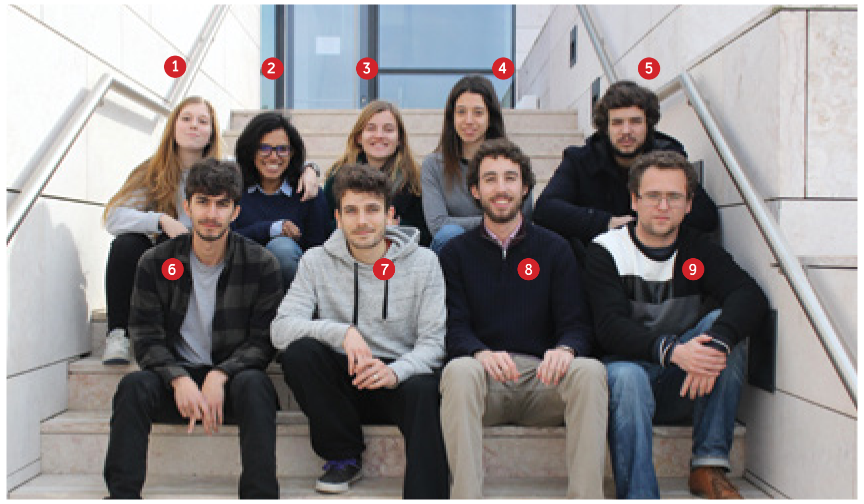
Education Committee: Eugenia Chiappe, Susana Lima

Coordinator: Thiago Carvalho

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.

During the first year of this four-year programme, students attend courses that cover basic topics in contemporary neuroscience. The courses have a strong practical component, which includes a variety of experimental preparations. During this year, students also perform lab rotations, which allow them to familiarise themselves with the research done in the different labs and help them with selecting the lab where they will conduct their doctoral research during the next three years.

INDP Class 2017



1 ANA GONÇALVES 2 RADHIKA RAJAN 3 RITA GIL 4 OIHANE HORNO 5 TIAGO COSTA
6 GONÇALO GUIOMAR 7 DARIO SARRA 8 JUAN CASTIÑEIRAS 9 ANDRES LAAN

Theses

PhD awarded to: **Gabriel Madirolas**
Title: *Collective intelligence in simple estimation problems*
Thesis Advisor: Gonzalo de Polavieja
(Collective Behaviour lab)

PhD awarded to: **Niccolò Bonacchi**
Title: *Spatial goals and actions in the orbitofrontal cortex*
Thesis Advisor: Zachary Mainen
(Systems Neuroscience lab)

PhD awarded to: **Sofia Soares**
Title: *Time in the basal ganglia: The contributions of striatal and midbrain dopamine neurons to timing behaviour*
Thesis Advisor: Joe Paton
(Learning lab)

PhD awarded to: **Jacques Bourg**
Title: *Amplification in Cortical Networks*
Thesis Advisor: Alfonso Renart
(Circuit Dynamics & Computation lab)

PhD awarded to: **Samantha L. Herbert**
Title: *How the nervous system responds to and regulates amino acid homeostasis*
Thesis Advisor: Carlos Ribeiro
(Behaviour & Metabolism lab)

PhD awarded to: **Samuel J. Walker**
Title: *More than fruit flies: neuronal mechanisms of nutrient selection in Drosophila*
Thesis Advisor: Carlos Ribeiro
(Behaviour & Metabolism lab)

PhD awarded to: **Bethania Cassani**
Title: *Role of the neurotrophic factors in ILC3*
Thesis Advisor: Henrique Veiga-Fernandes
(Immunophysiology lab)

MSc awarded to: **André Pombeiro**
Title: *Disentangling multiple factors shaping the activity of mice prefrontal cortical neurons during working memory*
Thesis Advisor: Alfonso Renart
(Circuit Dynamics & Computation lab)

MSc awarded to: **Mafalda Ferreira**
Title: *Functional characterisation of tumour-derived exosomes in the zebrafish xenograft model*
Thesis Advisor: Bruno Costa-Silva
(Systems Oncology lab)

CAJAL Advanced Neuroscience Training Programme

The CAJAL Advanced Neuroscience Training Programme consists of 4 yearly courses, 2 held at the Champalimaud Centre for the Unknown in Lisbon and 2 in Bordeaux Neurocampus. These two institutes were chosen to be the first centres in Europe that will host recurring neuroscience training courses, following a model that has been successfully running in the USA for decades.

CAJAL Advanced Course: Interacting with Neural Circuits

July 02 - 22, 2017

This three-weeks course combines a lecture series featuring top speakers from around the world with a practical "hands-on" introduction to the latest methods for probing neural circuits. The aim is to first teach students the theoretical foundation of the techniques (weeks 1 and 2), and then provide them with sufficient practical experience (weeks 2 and 3) so that they will be able to establish these approaches when they return to their laboratories.

CAJAL Course in Computational Neuroscience

August 06-26, 2017

Computational Neuroscience is a rapidly evolving field whose methods and techniques are critical for understanding and modeling the brain, and also for designing and interpreting experiments. Mathematical modeling is one of the few tools available to cut through the vast complexity of neurobiological systems and their many interacting elements. This three-weeks school teaches the central ideas, methods, and practice of modern computational neuroscience through a combination of lectures and hands-on project work.

Courses, Workshops & Events Highlights

AS CR GROWS, ITS CULTURE EVOLVES IN STEP WITH THE INDIVIDUALS THAT MAKE UP THE RESEARCH COMMUNITY. IN THE LAST FEW YEARS, CR MEMBERS HAVE INTRODUCED VARIOUS INITIATIVES THAT ENRICH THE SOCIAL AND SCIENTIFIC LIFE AT CR.

European Commission Open Science Workshop

June 20-21, 2017

Organisers: Megan Carey

Local Administrative Coordination: Ana Casaca, Anna Hobbiss

An important event in 2017, was a high-level workshop for the implementation of Open Science in the EU. The workshop gathered international experts to develop specific recommendations towards making Open Science a reality in the EU.

Locally, the workshop was coordinated by Megan Carey, a principal investigator at CR who is also a member of the RISE Open Science group, a special advisory committee appointed by Carlos Moedas, the European Commissioner for Research, Science and Innovation.

Manuel Heitor, the Minister of Science, Technology and Higher Education of Portugal, who delivered the workshop's closing remarks, echoed the RISE group's analysis that extreme competition, which is currently an integral part of scientific research, is incompatible with Open Science principles. He also emphasised the importance of open science communication, not only among scientists, but with society at large.

The 6th Champalimaud Symposium

Physiology: From Development To Disease

October 9-11, 2017

Chairs: Henrique Veiga-Fernandes, Eduardo Moreno, Carlos Ribeiro.

Administrative Coordination: CR Support Unit

One of the main highlights of 2017 was the annual Champalimaud Research Symposium, which this year had been a very special event as it served as the inaugural conference to launch the Champalimaud Biology of Systems and Metastasis Research Programme.

The theme of the symposium was "Physiology: from development to disease". It focused on modern physiology in development, ageing, immunity and cancer, bridging cutting edge biology research with disease oriented research.

The symposium featured lectures from 14 international leading experts, including a keynote lecture from Professor Bob Horvitz, winner of the 2002 Prize in Physiology or Medicine, shared with Sydney Brenner and John Sulston, "for their discoveries concerning genetic regulation of organ development and programmed cell death".

A

A - Open Science Workshop

Participants engaged in discussion led by a panel of specialists.

B - 6th Champalimaud Symposium

Talk presentation at the auditorium of the Champalimaud Centre for the Unknown.

B

List of invited speakers

H. Robert Horvitz (Massachusetts Institute of Technology, USA)

Caetano Reis e Sousa (The Francis Crick Institute, UK)

Carlos Ribeiro (Champalimaud Centre for the Unknown, Portugal)

Duojia Pan (UT Southwestern, USA)

Eduardo Moreno (Champalimaud Centre for the Unknown, Portugal)

Fujita Yasuki (Hokkaido University, Japan)

Henrique Veiga-Fernandes (Champalimaud Centre for the Unknown, Portugal)

Jean-Paul Vincent (The Francis Crick Institute, UK)

Jonathan Kipnis (University of Virginia, USA)

Josef Penninger (Institute of Molecular Biotechnology, Austria)

Linda Partridge (University College London, UK & amp; Max Planck Institute for Biology of Ageing, Germany)

Maria Blasco (Spanish National Cancer Research Centre, Spain)

Paul Frenette (Albert Einstein College of Medicine, USA)

Pierre Leopold (Institute Of Biology Valrose - iBV, France)

2017

Jan

21
Workshop
Science Careers Workshop - Graphic design for scientists
Gil Costa,
(CR SciCom Office)
*Organisers: Science Careers Team **

26
Colloquium
Cortical neural circuits for olfaction
Alexander Fleischmann,
Collège de France, France

Feb

02
Colloquium
Understanding the roles of amygdala-prefrontal connections through targeted optogenetic perturbation
Ofer Yizhar,
Weizmann Institute of Science, Israel

09
Colloquium
mGluR signalling dysfunction in neuropsychiatric disorders
João Peça
Center for Neuroscience and Cell Biology, University of Coimbra, Portugal

16
Colloquium
"Supraoptimal" visual-tactile integration in rats and underlying neuronal mechanisms
Mathew Diamond
SISSA – the International School for Advanced Studies, Italy

23
Colloquium
Animal research: time to talk!
Kirk Leech
European Animal Research Association

25
Workshop
Science Careers Workshop - How to communicate animal research
Kirk Leech,
(European Animal Research Association)

Mar

09
Colloquium
Local and global mechanisms mediating changes in intestinal homeostasis
Julia Cordero
University of Glasgow, Scotland

23
Colloquium
Breaking symmetry in the brain: from genes to neural circuits
Steve Wilson,
University College London, UK

25
Workshop
Science Careers workshop - science writing
Ana Gerschenfeld,
(CR SciCom Office)
*Organisers: **

Apr

20
Colloquium
Flexible control of speed of cortical dynamics
Mehrdad Jazayeri
Institute for Brain Research, MIT, USA

May

04
Colloquium
Why going nano on cancer healthcare?
João Conde
Massachusetts Institute of Technology, USA

11
Colloquium
Imaging and stimulating adaptive brain plasticity.
Heidi Johansen-Berg
Nuffield Department of Clinical Neurosciences, University of Oxford, UK

25
Colloquium
Multineuron approaches to studying cognition
Marlene Cohen
University of Pittsburgh

25
Workshop
Science Careers workshop - Focus on Pharma
Catarina Santos (Novartis), Gonçalo Rebelo de Andrade (Hovione)
*Organisers: **

Jun

05-08
CR Annual Retreat
Location: Zmar, Alentejo
Organisers: Ana Casaca, Anna Hobbiss, Christian Machens, Eduardo Moreno, Joana Maia, Joaquim Teixeira, Margarida Anjos, Mattia Bergomi, Raquel Tomas, Thabélò Khoboko

20-21
Workshop
European Commission Open Science Workshop
Organisers: Megan Carey (Champalimaud Centre for the Unknown, Portugal)
Admin. coordination: Ana Casaca, Anna Hobbiss

22
Colloquium
Mechanisms of adaptive behaviour across moments and millennia.
Vanessa Ruta,
The Rockefeller University, USA.

Jul

09-12
17th HFSP Awardees Meeting
Organisers: Carlos Ribeiro (Champalimaud Centre for the Unknown, Portugal), Guntram Bauer (Human Frontier Science Program)
Admin. coordination: Ana Casaca (Champalimaud Centre for the Unknown, Portugal), Anna Hobbiss (Champalimaud Centre for the Unknown, Portugal), Rosalyn Huie (Human Frontier Science Program)

02-22
Cajal Advanced Course
Interacting with neural circuits
Organisers: Michael Häusser (University College London, UK), Leopoldo Petreanu (Champalimaud Centre for the Unknown, Portugal), Menno Witter (Kavli Institute for Systems Neuroscience, Norway)
Admin. coordination: Simone Zacarias

Aug

06-26
(Additional Pre-School: August 01-04, 2017)
Cajal Advanced Course
Computational neuroscience
Organisers: Joe Paton (Champalimaud Centre for the Unknown, Portugal), Christian Machens (Champalimaud Centre for the Unknown, Portugal), Jakob Macke (Research Center Caesar, Associate of Max Planck Society, Germany).
Administrative coordination: Simone Zacarias

Sep

07
Colloquium
Applications of light sheet microscopy in developmental biology
Pavel Tomancak,
Max Planck Institute of Molecular Cell Biology and Genetics

14
Colloquium
The circuit mechanism for courtship behaviour in *Drosophila melanogaster* and beyond
Daisuke Yamamoto
Tohoku Neuroscience Global COE Basic & Translational Research Center for Global Brain Science, Japan.

18-22
Alzheimer's Global Summit
CR Affiliated Organisers: Rui Costa and Albino Oliveira Maia
For full information please see: https://alzheimersummitlis-bon2017.com/

21
Colloquium
Mapping the neural substrates of behaviour using computer vision
Kristin Branson
Janelia Research Campus, Howard Hughes Medical Institute, USA

Oct

09-11
6th Champalimaud Neuroscience Symposium
Physiology: from development to disease
Chairs: Henrique Veiga-Fernandes, Eduardo Moreno, Carlos Ribeiro
Administrative coordination: Ana Casaca, Anna Hobbiss, Catarina Ramos, Gil Costa, Raquel Gonçalves

19
Colloquium
Understanding attractor dynamics and abstract internal representations.
Vivek Jayaraman
Janelia Research Campus, Howard Hughes Medical Institute.

26
Motor primitives in time and space by targeted gain modulation in recurrent cortical networks
Tim Vogels
University of Oxford

Nov

02
Colloquium
How to improve translational brain research in Europe
David Nutt
Edmond J. Safra
Imperial College London

04
Workshop
Science Careers Workshop - Interpersonal communication in science
Guest speakers: Kay Scorah (Have More Fun), Marta Moita (Champalimaud Centre for the Unknown), Rita Venturini (Champalimaud Centre for the Unknown)
*Organisers: **

Dec

06
Workshop
Science Careers Workshop - How recruitment processes work
HR representatives from the pharmaceutical companies Johnson&Johnson, MSD (Merck) and Bial
*Organisers: **

07
Colloquium
Neurodevelopmental disorders: from molecular mechanisms to novel treatments
Gaia Novarino
Institute of Science and Technology, Austria

14
Colloquium
Concurrent physiological multisite-recordings & brain imaging: study of dynamic connectivity related to system and synaptic memory consolidation
Nikos K. Logothetis
Max Planck Institute for Biological Cybernetics, Tübingen, Germany

** Science Careers Team: Anna Hobbiss, Ekaterina Vinnik, Catarina Ramos, Clara Ferreira, João Afonso, Maria Inês Vicente, Raquel Gomes, Silvana Araújo.*

Culture Highlights

AS ONE OF THE MEANS TO CREATE AN ENVIRONMENT WHERE INDIVIDUAL RESEARCHERS, IN ALL CAREER STAGES, ARE FAMILIAR WITH THE WORK OF EACH OTHER, SEVERAL ACTIVITIES HAPPEN REGULARLY AT THE CCU.

TWO OF THESE ACTIVITIES ARE THE INTERNAL WEEKLY SEMINAR SERIES AND THE CR ANNUAL RETREAT.

CISS

Champalimaud Internal Seminar Series

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

CR Annual Retreat

@Zambujeira do Mar

June 5-8, 2017

Location: Zmar, Alentejo

Organisers: Ana Casaca, Anna Hobbiss, Christian Machens, Eduardo Moreno, Joana Maia, Joaquim Teixeira, Margarida Anjos, Mattia Bergomi, Raquel Tomas, Thabèlò Khoboko.

The Annual Retreat is a major event that gathers all CR members in a remote location for a period of four days. The retreat serves the purpose of familiarising individual scientists with each other's work and creating a sense of community. It combines scientific events, such as poster sessions, with creative cultural and social activities.

As the CR continues to grow in numbers and scope of research, these events, now more than ever, serve as an important means of maintaining the scientific culture of collaboration and cooperation at CR.

A

A - Champalimaud Internal Seminar Series

The CR community gathers at the Seminar Room for the presentations of ongoing projects.

B, C - Annual Retreat Activities

The CR annual retreat features various group activities and social events.

B

C

Science Careers

Science Careers Workshop Series

Organisers: Anna Hobbiss, Catarina Ramos, Clara Ferreira, João Afonso, Maria Inês Vicente, Raquel Gomes, Silvana Araújo.

The Science Careers Workshop Series was established with the goal of raising awareness amongst PhD students and postdoctoral researchers about the breadth of possible science careers, both within and outside of the academia, and help participants develop skills required for these career paths.

This series is organised in collaboration between investigators and the Science Communication Office.

In 2017, six workshops were organised on the following topics:

- Graphic design for scientists (Gil Costa/ SciCom Office)

- How to communicate animal research (Kirk Leech/EARA, Isabel Campos and Catarina Certal/CR Platforms)

- Science writing (Ana Gerschenfeld/ SciCom Office)

- Focus on pharma (Gonçalo Rebelo de Andrade/Hovione, Claudia Quiroga/Quintiles, Catarina Santos/ Novartis);

- Interpersonal communication in science (Kay Scorch/facilitator and researcher havemoref Unlimented, Ekaterina Vinik, Rita Venturini and Marta Moita/scientists at CR)

- How recruitment processes work (Adelaide Nunes and Llanos Verdu/ Johnson&Johnson, Inês Ribeiro/ Jansen, Filipa Figueira and Dr. Paula Martins/MSD; Lígia Moreira/Bial).

The Science Careers Workshop Series is supported by CR's Kickstarter initiative, in which labs dedicate resources to finance projects that are considered to be beneficial to the entire community.

Bake Sale

Monthly Charity Bake Sale

Organisers: Irene Argudo, Marcia Matos, Victòria Brugada.

Bakers: Ana Gonçalves, Ana Raquel Tomás, Ana Santos, Antonia Groneberg, Bruno Ceña, Cecilia Mezzera, Célia Baltazar, Diogo Matias, Irene Argudo, Joana Lamego, Joana Monteiro, José Maria Moreira, Marcia Matos, Margarida Brotas , Marina Fridman, Francisco Romero, Pietro Vertechi, Rodrigo Dias, Samuel Walker, Silvana Araujo, Sophie Dias, Tatiana Silva, Tiago Marques, Victòria Brugada.

The monthly charity bake sale started in 2017 by a group of CR members dubbed "The Baking Lab", who decided to channel their love of baking towards charity. Besides the long list of dedicated bakers who rotate between events, other volunteers also contribute with juice, coffee and tea that benefactors receive for free to accompany their afternoon pastry.

In 2017, the group organised eight events to support both national and international charities: Rafeiros SOS; Hot Food Idomeni; Centro de apoio ao sem abrigo; Animais da Rua; Victims of the fires in Portugal; À procura do nosso milagre; APAMCM; and Uma árvore para floresta.

F

D - Zmar

The 2017 CR annual retreat was held at the Zmar resort in Alentejo.

E - Science Careers Workshop Series

This workshop, titled "Careers at the Interface of Science" presented the diversity of jobs available to individuals with scientific training. It also included a networking session where participants interacted with a diverse group of professionals currently working at the interface of science.

F - Monthly Bake Sale

Selling homemade pastries for charity at the first floor coffee area.

D

E

Outreach Activity

27
ACTIVITIES

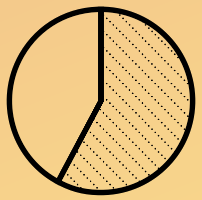
13
DIFFERENT LABS

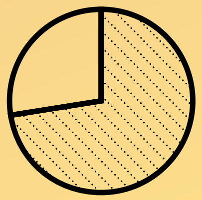
1
SCIENTIFIC PLATFORM

from

by >50
CHAMPALIMAUD RESEARCH VOLUNTEERS

8
DIFFERENT SUPPORT UNITS

42% Male

58% Female

27% Non -Portuguese

73% Portuguese

January

- **Talk "O indivíduo, um olhar sobre a neurociência"**
  Location: Unilever Offices
  Public: Adults
- **High-school Visit**
  Location: CCU
  Public: High school students

February

- **Ciência Viva school Visit**
  Location: CCU
  Public: Primary school students
- **Workshop "Science communication meets multimedia"**
  Location: CCU
  Public: Students from the Institute of Education and Sciences in Lisbon

March

- **Ar in a Bar: Love & Sex in the Mind!**
  Location: Chimera Brewpub, Lisbon
  Public: Adults
- **High-school Visit**
  Location: CCU
  Public: High school students
- **Rota do Cérebro (Brain Awareness Week 2017)**
  Location: The Market of Algés
  Public: General public (all ages)

April

- **High-school Visit**
  Location: CCU
  Public: High school students
- **TEDxISTAlameda**
  Why is time so variable?
  Location: Instituto Superior Técnico
  Public: College students

May

- **Ar in a Bar: Free Will**
  Location: Chimera Brewpub, Lisbon
  Public: Adults
- **FameLab**
  Location: Pavilhão do Conhecimento - Centro Ciência Viva
  Public: High school and college students
- **Bibliotecando MAAT**
  Location: Museu de Arte, Arquitetura e Tecnologia (MAAT), Lisbon
  Public: Adults
- **Special class by a CR scientist**
  Location: Escola da Torre, Lisbon
  Public: Primary school students
- **Special class by a CR scientist**
  Location: Escola D. Filipa de Lencastre, Lisbon
  Public: Primary school students
- **Cá Dentro (Neuroscience for big brains and smaller ones)**
  Location: CCU Auditorium
  Public: Families (8-12yo and adults)
- **High-school Visit**
  Location: CCU
  Public: High school students

June

- **Ocupação Científica Jovens nas Férias - Summer School**
  Location: Teaching Lab, CCU
  Public: High school students

July

- **Special class by a CR scientist**
  Location: Externato Sta Catarina, Algés, Oeiras
  Public: Preschool and Primary school students

September

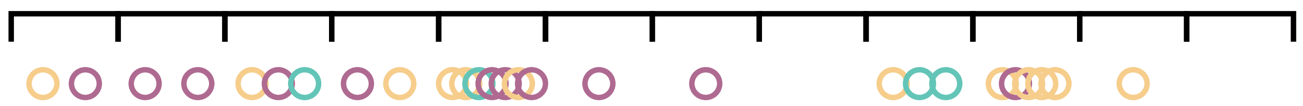
- **European Researchers' Night**
  Location: Pavilhão do Conhecimento, Lisbon
  Public: General public (all ages)
- **Launching photo exhibit "Reflections"**
  Location: CCU
  Public: General public (all ages)
- **Presentation at the Discursos do Cérebro Conference**
  Location: Culturgest, Lisbon
  Public: Adults

October

- **Ar | Respire Connosco Event: Limit(less) – Pushing the boundaries of muscle and mind**
  Location: CCU
  Public: Adults
- **High-school Visit**
  Location: CCU
  Public: High school students
- **Presentation at the "Brain and ethics: New challenges" Event**
  Location: Fundação Calouste Gulbenkian, Lisbon
  Public: Adults
- **Presentation at the "Human Entities: Imaginando o impacto da inteligência artificial"**
  Location: Trienal de Arquitectura de Lisboa
  Public: Adults
- **Presentation at the "HUMANOS - Onde começa a nossa natureza" Event**
  Location: Casa das Histórias de Paula Rego, Cascais
  Public: Adults

November

- **Presentation at the "E agora... para onde vamos? - O olhar das neurociências"**
  Location: Fórum Lisboa
  Public: Adults



Science Communication Unit
Highlights

ONE OF CR'S STATED GOALS IS TO SHARE KNOWLEDGE NOT ONLY WITHIN THE SCIENTIFIC COMMUNITY, BUT ALSO WITH THE COMMUNITY AT LARGE. MANY CR RESEARCHERS, AT ALL CAREER STAGES, ADOPT THIS VISION AND CHOOSE TO ORGANISE AND PARTICIPATE IN VARIOUS OUTREACH ACTIVITIES, BOTH AT AND OUTSIDE OF THE CCU.

SCIENCE COMMUNICATION OFFICE

Coordinator: Catarina Ramos

Team: Gil Costa, Liad Hollender, Ana Gerschenfeld, Maria Inês Vicente, Shira Lottem

A leading scientific institution should not only produce the best quality research but also work with different society sectors to share with them the wonders of science, for the benefit of future citizens. To produce a long-lasting impact, science must reach society and engage it in its discoveries and breakthroughs. One of the core missions of the Champalimaud Research (CR) is to demystify science so the public can understand the importance of what we do and is invited to engage with us in the amazement of scientific discovery.

The CR Science Communication Unit has been actively involved in multiple initiatives that start at the CCU but go beyond its walls and reach a diversity of audiences.

This Unit is responsible for disseminating information on the activities and ongoing or emerging objectives of CR to all relevant parties; for maintaining fluent internal and external communication channels, including CR's online presence; liaising with the media; and the production of communication documents/materials, such as the annual report. This Unit also coordinates science communication initiatives that range from science education and outreach events to the organisation of scientific meetings. The team also supports the CR community in their scientific endeavors, with in-house

BRAIN AWARENESS WEEK 2017

Rota do Cérebro

March 18, 2017

This event has transformed the Algés Market into a great celebration of the brain, neuroscience, scientists and the curious and informed society!

The day was divided into two sessions; in the morning, between the fish and the flowers, CR researchers welcomed visitors with microscopes, neurons and hands-on activities based on the research done at the CCU. In the afternoon, there was a special Science Stand-Up show and informal chats about science between scientists and market visitors.

A - Rota do Cérebro

Visitors to the market in Algés engage in outreach activities organised by CR for the 2017 Brain Awareness Week.

B - Cá Dentro

Children gather to learn about the diversity of neurons in the brain during an outreach events for families at the auditorium of the CCU.

A

B

NEUROSCIENCE FOR BIG BRAINS AND SMALLER ONES

Cá Dentro

May 12, 2017

Held at the CCU Auditorium, Cá Dentro (Here Inside) engaged young minds with activities, games, challenges and conversations, all in a celebration of neuroscience.

Many CR scientists volunteered in this event, demonstrating various aspects of the work done at CR in a fun and engaging way. The event was organised in collaboration with the publishing house Planeta Tangerina on the occasion of their release of the neuroscience book for children - Cá Dentro.

AR

AR in a Bar

March & May 2017

Ar in a Bar is one of the offshoots of the Ar family (the others being Ar Events and the online Ar Magazine). In these events CR scientists engage the public in a cosy, friendly atmosphere and have interesting discussions about many different topics in small groups. Two such events took place in 2017, titled "Free Will" and "Love & Sex in Mind!".

AR | Respire Connosco Event: Limit(less) – Pushing the boundaries of muscle and mind

October 2017

This public outreach event was a partnership between Ar | Respire Connosco, an outreach initiative of CR, and the Volvo Ocean Race. It explored our understanding of what limits mean, both physically and mentally, through a combination of a scientific and personal perspectives.

In addition to engaging presentations by scientists, the event featured a roundtable discussion with some of the best sailors in the world who have competed in the Volvo Ocean Race. These athletes shared with the audience their unique experiences in living in one of the most extreme and dangerous environments in the planet and how they reached and overcame their own limits.

PHOTO EXHIBIT

Celebrating 10 Years of Research at Champalimaud

September 2017

How does the brain encode time? How does the body decide which cells get to live and which have to die? *Reflections: celebrating 10 years of Champalimaud Research*, was a public photo-exhibit that presented answers to these and many other questions pursued by scientists at Champalimaud while providing a unique view into the Centre's research life.

The exhibit was produced to commemorate the tenth anniversary of the Champalimaud Research programme, celebrated in 2017. The goal of the exhibit was to show the journey of the last ten years by sharing it with the public at large.

In addition to showcasing CR's research, the exhibit also provides a unique view into the daily lives of the scientists of CR. Each exhibit panel has two sides; one presents a scientific result, the other a unique aspect of research life. In this way, the audience received a comprehensive 'tour' of research life.

C - Limit(less) - Pushing the boundaries of muscle and mind

Presentation by Tiago Marques, one of the hosts of this AR | Respire Connosco event.

D - AR in a BAR

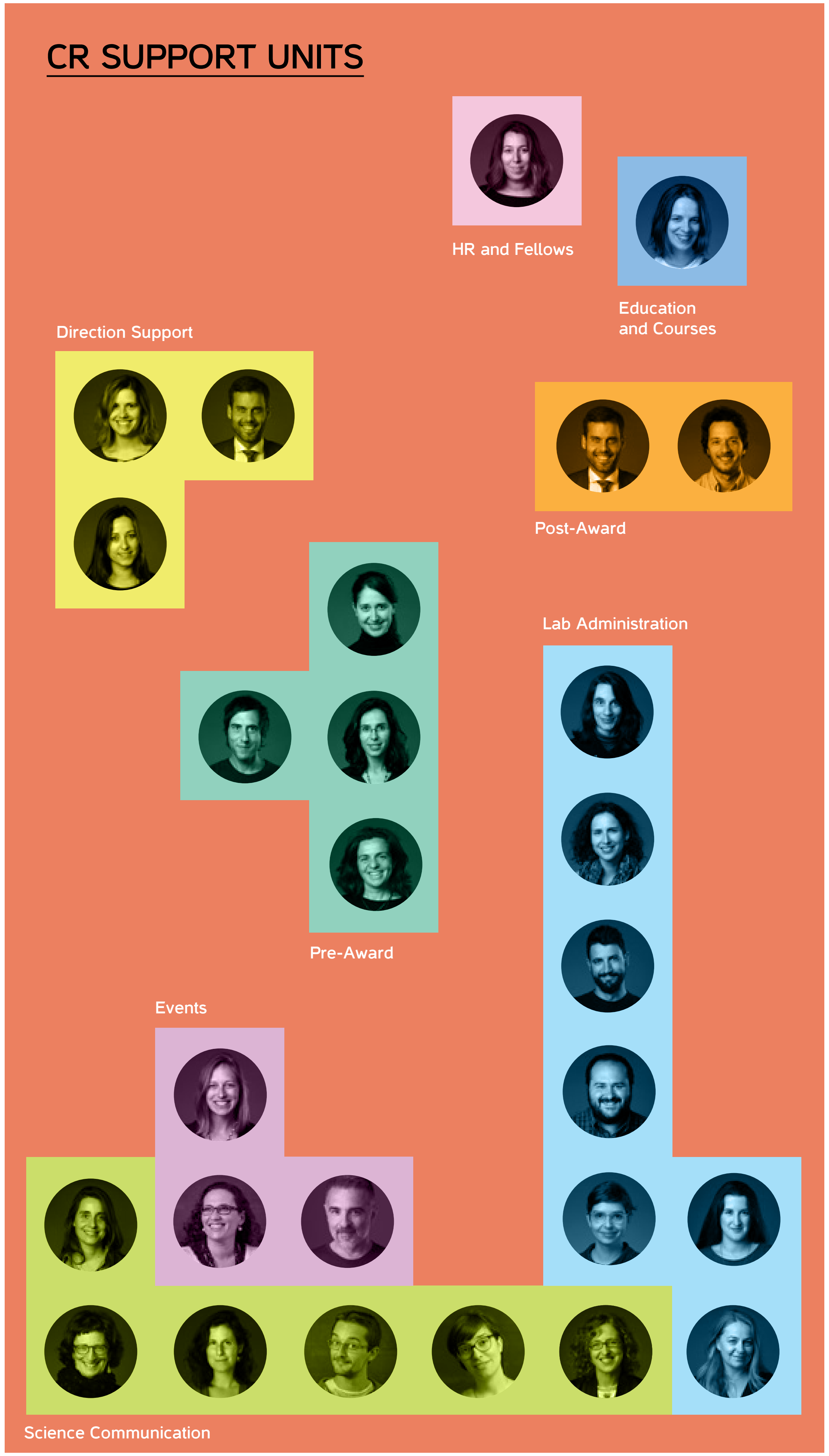
Event participants gather to listen to presentations by scientists at the Chimera Brewpub in Lisbon.

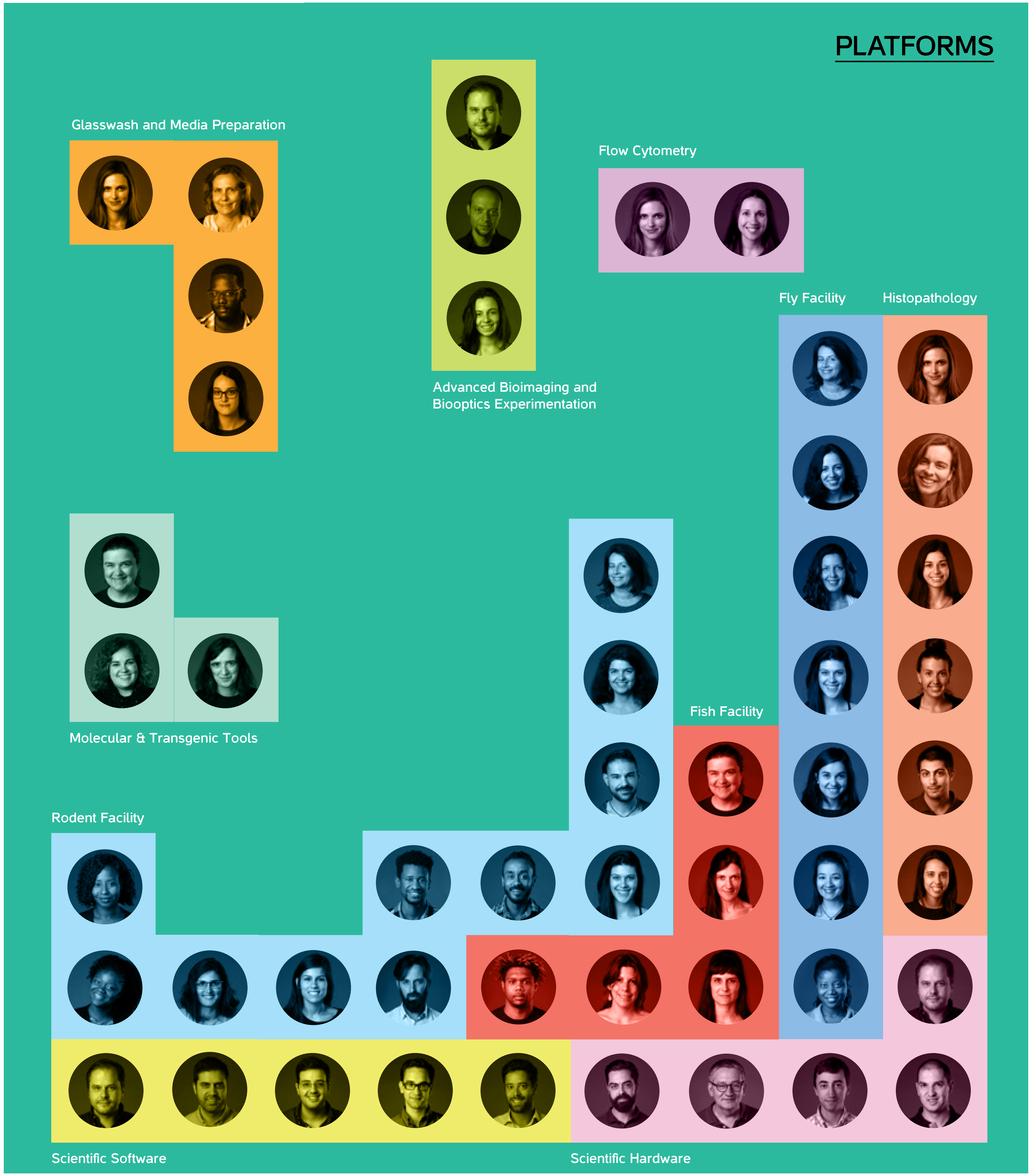
E - Photo Exhibit

Visitors viewing the exhibit

E

D


CR SUPPORT UNITS
HR and Fellows
Education
and Courses
Direction Support
Post-Award
Lab Administration
Pre-Award
Events
Science Communication


PLATFORMS
Glasswash and Media Preparation
Flow Cytometry
Advanced Bioimaging and
Biooptics Experimentation
Fly Facility
Histopathology
Molecular & Transgenic Tools
Fish Facility
Rodent Facility
Scientific Software
Scientific Hardware

CR Support Units Highlights

THE UNITS PROVIDE ALL ADMINISTRATIVE, FINANCIAL AND OPERATIONAL ASSISTANCE TO THE CR COMMUNITY. ACCOMPANYING THE EVOLUTION AND GROWTH OF CR, THE SUPPORT PROVIDED TO CR'S SCIENTISTS CONTINUOUSLY GROWS IN ORGANISATION AND CAPACITIES.

ORI

Office of Research Internships

The Office of Research Internships began operating with the aim of systematising the process of internship applications of undergraduate students. The Office works via the HR & Fellows Unit, which receives the applications via a designated form on CR website, channels the applications to the chosen labs and coordinates communications with candidates in accordance with the response of the group heads. In 2017, the office received 66 applications from ten different countries, of which, 17 were accepted to join CR groups.

Direction Support

Executive Coordinator: Inês Soeiro

Operations Manager: Cátia Feliciano

Financial Manager: Joaquim Teixeira

The Direction Support Team acts as the executive arm of the Research Directors, receiving, delegating and implementing direct instructions from the Research Direction Team. The team meets with the Directors on a regular basis, for updates on the daily life of CR and any pressing matters or roadblocks. This team also serves as a primary contact point for any problem-solving needs within CR, being able to advise on the resources available to the CR community.

Events

Coordinator: Anna Hobbiss

Events Organiser: Ana Casaca

AV and Multimedia Technician: Alexandre Azinheira

The Events unit supports scientific events organised by CR. From the large annual events like the CR Retreat and Symposium to our weekly CISS and Colloquium, the team helps with all event-related details, from conception and planning to logistical details such as travel and accommodation, venue set-up, catering and event management. This Unit also supports the Faculty's events, and other ad-hoc events such as outreach initiatives. The team also consolidates the management of all communal audio-visual equipment, as well as expertise in videography and photography.

Education and Courses

Teaching Lab Manager: Simone Zacarias

The Education & Courses Unit is in charge of the organisation and daily management of classes of the International Neuroscience Doctoral Programme (INDP), CAJAL courses and external teaching weeks with other institutions (such as GABBA, IGC and MIT). The organisation of the Teaching Lab space and materials is another main function of this Unit, as well as supporting the INDP recruiting process. The Unit also runs the Teaching Lab and Classroom, which are the hubs of all courses happening at CR.

Lab Administration

Coordinator: Raquel Gonçalves

Lab Managers:
Ana Margarida Nunes, António Raposo, João Cruz, Rita Saraiva, Telma Carrilho, Vesna Petojevic

The Lab Administration team deals with administrative support for the Labs, including budget management and execution, purchasing, travel arrangements and more. To that end, team members coordinate with other CR support units and CF departments as well as external agents like the suppliers, shipping companies and customs.

HR and Fellows

HR Officer: Teresa Carona

The HR & Fellows Unit advises all CR personnel on all the necessary procedures for registration as a CR member: contracts, social security, medical insurance, visas, CCU cards, language classes at CCU, etc. HR also supports all CR recruiting, including the recruiting process for the International Neuroscience Doctoral Programme.

Pre-Award

Coordinator: Joana Lamego

Grants Managers: Bruno Ceña, Filipa Cardoso, Mariana Santa-Marta

The Pre-award team supports CF Research in all stages of the submission of research applications to external funding: from the identification of putative funding opportunities, to the validation of the expression of interest by the CF Research Direction Team, up to the negotiation of successfully funded applications. The team offers different types of support, from basic administrative support to non-scientific writing/proposal reviewing or even supporting proposal development itself.

Post-Award

Financial Manager: Joaquim Teixeira

Grants Officer: Francisco Semedo

External Consultants: Carina Quintal, Inês Bonifácio, Gonçalo Pardal, Henrique Moreira, Pedro Monteiro, Tatiana Freitas

The Post-Award Team provides managerial and administrative support to researchers on grants, fellowships, awards and contract research. This includes monitoring and controlling financial execution, providing help with scientific reporting, ensuring full compliance with contractual obligations, performing budget oversight and adjustments, liaising with external auditors and communicating with funding agencies. The team also functions as a facilitator, creating a bridge between the CR Scientific Community and Support Units, Accounting and Financial Department, as well as external collaborators and funding agencies. The team takes most of the bureaucratic burden off the researchers' shoulder so that they can focus on what they are best tailored to do: outstanding scientific discovery.

Science Communication

Coordinator: Catarina Ramos

Science Writers: Ana Gerschenfeld, Liad Hollender

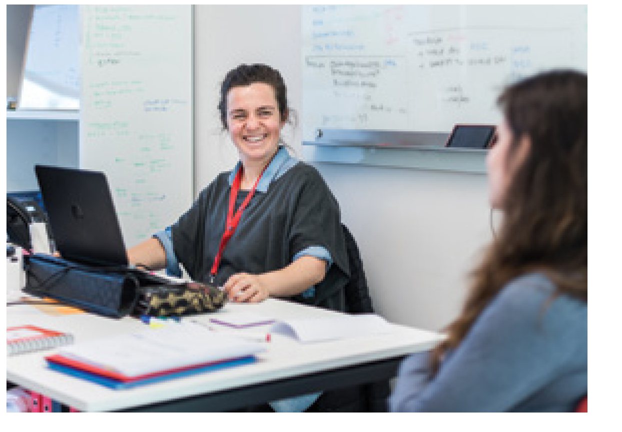
Science Graphic Designer: Gil Costa

Graphic & Education Designer: Shira Lottem

Science Education and Outreach Officer: Raquel Gomes

The CR Science Communication Unit is actively involved in multiple initiatives that start at the CCU but go beyond its walls and reach a diversity of audiences. It is responsible for disseminating information regarding the activities and ongoing or emerging objectives of CR to all relevant parties. The unit maintains fluent internal and external communication channels, including CR's online presence, liaises with the media, produces communication documents/materials, such as the annual report. This Unit also coordinates science communication initiatives that range from science education and outreach events to the organisation of scientific meetings. The team also supports the CR community in their scientific endeavors, with in-house scientific design and illustration.

A



B

A,B - Members of the CRSU team.
Members of the Pre-award team (top) and Lab Administration team (bottom).

Scientific and Technological Platforms Highlights

THE SCIENTIFIC AND TECHNOLOGICAL PLATFORMS OF THE CHAMPALIMAUD CENTRE FOR THE UNKNOWN CARRY OUT TECHNICAL-SCIENTIFIC AND SPECIALISED SUPPORT WORK FOR THE ACTIVITIES OF RESEARCH GROUPS AND CLINICIANS. THE PLATFORMS OPERATE IN A WIDE RANGE OF AREAS, FROM THE DEVELOPMENT OF SOPHISTICATED TECHNOLOGIES IN ANIMAL MODELS, IMAGING TOOLS, HARDWARE AND SOFTWARE, TO RESOURCE MANAGEMENT AND RESEARCH INFRASTRUCTURES.

GRANTS

1.8M Euros awarded to CR Scientific and Technological Platforms as part of the Portuguese Scientific Infrastructures Roadmap

The Portuguese Research Infrastructures Roadmap (defined in 2014) integrates several research infrastructures that create, develop and provide the scientific community with essential tools that enable a more successful participation in European and global frontier research projects.

In June 2017, the Champalimaud Research Scientific and Technological Platforms received €1.8 Million to support their participation in three National Research Infrastructures:

CONGENTO

The Consortium for Genetically Tractable Organisms

CONGENTO is a collaborative effort between four Lisbon Research Institutions. It aims to develop infrastructures that will provide state-of-the-art services to research groups. Initially, it will focus on 3 model organisms widely used in biomedical research - fruit flies, zebrafish and mice.

PPBI

Portuguese Platform of BioImage

PPBI is a centrally managed consortium of research universities and institutes across Portugal that together create a common functional bioimaging platform dedicated to promoting the technical integration of shared resources available to various fields in biology and medicine.

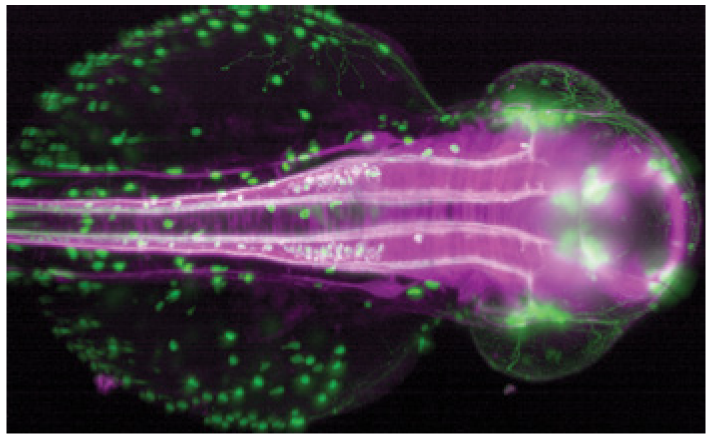
BioData.pt

Portuguese Biological Data Network (BioData.pt)

BioData.pt is a distributed infrastructure for biological data. It is organised around several domains of knowledge and application, including general scientific, technical and educational platforms, industry and

A

B



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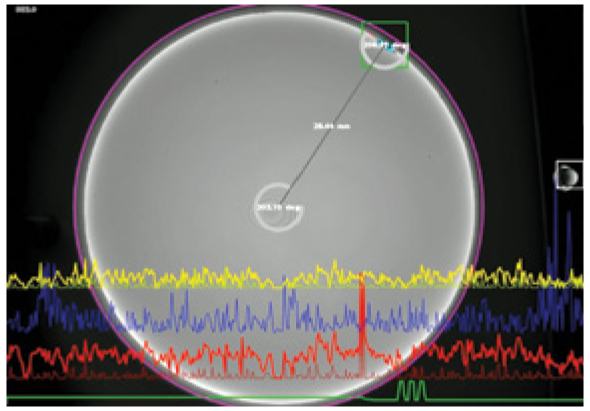


A - CONGENTO

CR platforms participate in the consortium CONGENTO. One of the services it offers is the production of different variants of transgenic fruit flies.

B - PPBI

A view of a zebrafish embryo during development captured by the ABBE Platform. The platform is an active partner of the Portuguese Platform of BioImage (PPBI), where it provides access to state-of-the-art equipment and high level expertise.

B - BioData.pt

Computer vision software developed by the Scientific Software Platform to identify defensive behaviours in fruit flies. This is an example of data that will be available to researchers in the BioData.pt portal.

Scientific and Technological Platforms

Advanced BioImaging and BioOptics Experimental (ABBE)

Coordinator: Pedro Garcia da Silva
Group Head: Davide Accardi
Technician: Leonor Morgado

In 2017, the Optical Imaging and Microscopy Platform was re-launched as the ABBE platform. ABBE includes several improvements: (1) the hiring of a team of experts apt to support users with all stages of the experimental process from design to analysis; (2) the implementation of state-of-the-art techniques that facilitate a multi-scale research approach which spans imaging protein interactions to whole organisms; and (3) ABBE forms a bridge between the clinical and basic research at the CCU by introducing methods across fields. In addition to the newly implemented improvements, the platform maintains its high standards and performance by carrying out its own research on method optimization and collaborates with other Champalimaud Foundation platforms to customize the sample preparation and imaging workflow to the needs of the users.

Scientific Hardware

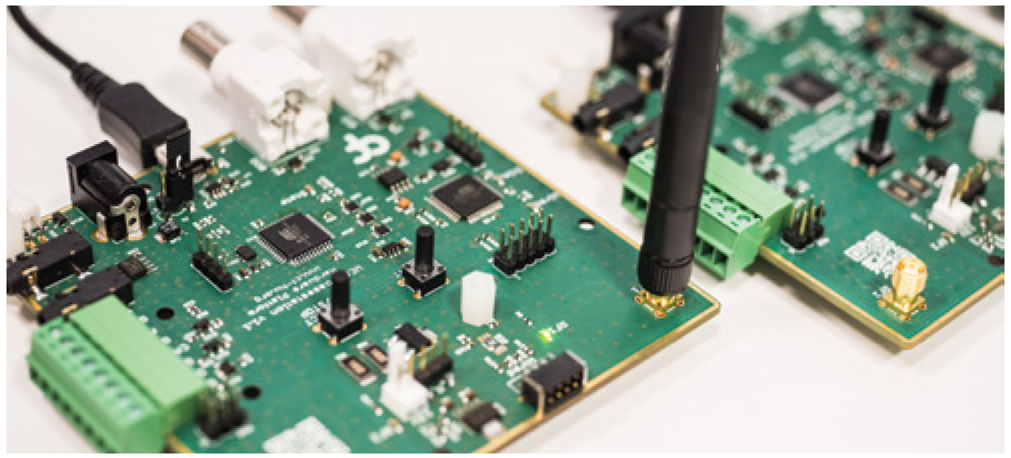
Coordinator: Pedro Garcia da Silva
Group Head: Filipe Carvalho
Hardware Developers: Artur Silva, Paulo Carriço
Technician: Dario Bento

The goal of the Scientific Hardware Development Platform is to facilitate research at the individual, group and programme level, by proving the full pipeline of experimental hardware development: from requirement specification and analysis, to design, development, implementation, validation procedures and testing execution. It also provides diverse services, including 3D printing and the day-to-day support and management of the Electronic and the Mechanical Workshops.

Scientific Software

Coordinator: Pedro Garcia da Silva
Group Head: Ricardo Ribeiro
Cloud Specialist: Joao Baúto
Data Manager: Hugo Cachitas
Software Developer: Sérgio Copeto

The aim of the Scientific Software Platform is to support the high-level scientific research by providing high-quality software support and ensuring the performance of CR computational infrastructures. With educational backgrounds in Software, Electrical and Physics Engineering, the platform's team members have a broad range of skills and knowledge in areas such as computer vision, image processing, machine learning, hardware control, graphics, web, data management and systems administration. In 2017, the team focused on two main activities: (1) the development of the PyBpod and Python Video Annotator for behavioural analysis, and (2) the improvement of the data flow pipeline. The second activity was achieved by the construction of a high performance computational and storage cluster and by the installation of an internal high speed network to connect the data acquisition equipment to the computational resources.



Circuit Boards.

One of many tools manufactured by the Scientific Hardware Platform.

Histopathology

Coordinator: Tânia Vinagre

Group Head: Ana Santos

Technicians: Inês Marques, Maria Inês Romano, Sérgio Casimiro, Susana Dias

The Histopathology Platform provides specialised services to all the scientific community and aims to offer a personalised service tailored to each of its users objectives. For that purpose, the Histopathology Platform currently has available the following services: (1) Tissue sectioning, using vibratomes, cryostats and sliding microtomes; (2) Special histochemistry stains which allow to distinguish different tissue components and morphology; (3) Immunohistrochemistry techniques in slides, free-floating and whole mounting methods that allow to identify and quantify the presence of specific tissue's antigens/ proteins; and (4) Brain clearing techniques, with the purpose of getting completely transparent samples, allowing the observations of whole mounting.

Flow Cytometry

Coordinator: Tânia Vinagre

Group Head: Ana Vieira

The Flow Cytometry Platform was established in April 2017 with the mission to provide both to the Champalimaud community and to external groups, technical and scientific advice regarding the use of flow cytometric technologies. These include collaboration on design, data acquisition, analysis and interpretation. The Flow Cytometry Platform is one of the founders of the FLxFlow - a Portuguese network for Flow Cytometry, which aims to bring together core Flow Facilities in the Lisbon area with the goal of enabling the access of scientists to cutting edge applications.

Glasswash and Media Preparation

Coordinator: Tânia Vinagre

Group Head: Maria José Vito

Technicians: Maria Madalena Martins, Patrick Teca, Soraia Rodrigues

The Glasswash and Media Preparation Platform provides clean and sterilised labware such as glass, plastics and instruments to investigators and laboratories. This Platform also prepares high quality tissue culture and bacteriological media required for standard research protocols.

Fly Facility

Coordinator: Isabel Campos

Senior Technician: Liliana Costa

Technicians: Ana Rita Pereira, Joana Couceiro (CONGENTO), Sofia Silva, Zichiena Zovo

The Fly Facility is a multi-room platform central to all researchers using *Drosophila* as a model system. This Platform offers state-of-the-art conditions for *Drosophila* breeding, maintenance and manipulation, supporting researchers in establishing, applying and developing advanced genetic methods. The Platform has dedicated staff to ensure proper functioning of shared equipment that also provide technical services to all users. Importantly, the highly trained Platform team will perform high-quality, standardised and reproducible routine protocols and specialised, technically demanding services, difficult to carry out in individual labs and often outsourced.

Rodent Facility

Coordinator: Isabel Campos

Veterinarian: Dolores Bonaparte

Technicians: Andreia Madalena, Carlos Silva, Catarina Craveiro, Cláudio Macedo, Erineo Silva, João Pereira, Natacha Leonardo (CONGENTO), Rita Torre, Wilcilaya Pontes, Wilma Sobral

The Rodent Facility supports experimentation conducted under CF Research Programmes. In addition to normal husbandry routines, the Platform supports specialised services such as colony management, line genotyping, transgenic generation, rederivation and assisted reproduction techniques. To ensure the application of suitable and humane techniques, the Platform complies with international best practices as well as national and european legislation and guidelines for animal accommodation, care and experimentation. Importantly, animal care and use is carefully supervised and monitored by the internal Animal Welfare Body, the Vivarium technicians and the attending veterinarian, to ensure that all procedures are performed according to the 3Rs (Replacement, Reduction and Refinement): alternatives to animals are used whenever possible, the number of animals is minimised, and any discomfort or pain possibly experienced by the animal are minimised and weighed against the potential benefits for science.

Molecular and Transgenic Tools

Coordinator: Ana Catarina Certal

Senior Research Technician: Ana Raquel Tomás

Senior Research Technician: Ana Cunha

The Molecular and Transgenic Tools Platform (MTTP) performs complex transgenic and gene editing projects. It assists users in all stages from the conceptual design to the final animal delivery by providing support in molecular biology techniques from basic services such as production of competent bacterial cells or primer design, to complex cloning of knock-out and knock-in constructs to generate new zebrafish, fly or mouse models. The MTTP also encompasses a viral-vector production service and has several collaborations for continuous development and implementation of new viral systems. The Platform acts as a hub of shared resources and expertise not only for the CR, but also for the national and international research communities by providing services through CONGENTO, the Consortium for Genetically Tractable Organisms.

Fish Facility

Coordinator: Ana Catarina Certal

Senior Technician: Joana Monteiro

Facility Manager: Sandra Martins

Technicians: Carolina Cabrera (CONGENTO), Catarina Craveiro, Rita Almeida, Seidy Semedo

The Fish Faciloty applies rigorous health and welfare standards in the housing and breeding of zebrafish, the second most used animal model in biomedical research. It closely works with CR's Molecular and Transgenic Tools Platform to provide advanced research services. The Platform also collaborates with other CR Platforms and external institutions to develop new protocols and technologies, which are then communicated via peer-reviewed publications and presentations at international meetings. In addition, it participates in the development of an integrated database for zebrafish facilities and in new automation solutions for zebrafish husbandry. The platform is also part of the Consortium for Genetically Tractable Organisms (CONGENTO), where it plays a pivotal role by delivering zebrafish services to both the national and international research communities.

The Fly Room.

Tubes containing fruit flies.

Champalimaud Research
www.research.fchampalimaud.org

Follow us

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