Queensland Brain Institute **2015 Annual Report**

The University Of Queensland
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QBI

Queensland Brain Institute

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Cover Image: *Synaptic junctions* by **Anita Goldinger**
A representation of neuronal connectivity within the brain.
From the 2015 QBI Art in Neuroscience collection.

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UQ Vice-Chancellor and President's report

THROUGHOUT 2015 THE Queensland Brain Institute (QBI) continued its exceptional tradition of adding to global knowledge of the human brain, strengthening efforts to address some of humanity's most difficult diseases and disorders.

The bulk of the Institute's tremendous work is carried out by some 500 staff and students, who all contribute in their own ways to creating beneficial change. As well, sound leadership has been a hallmark of QBI since its inception, and in 2015, after a global search, the directorship passed from Professor Perry Bartlett to Professor Pankaj Sah.

Pankaj, who was an inaugural QBI group leader, is well known for his research into neural circuits in the amygdala, an area of the brain involved in emotional processing. He is also Director of the Australian Research Council (ARC) Science of Learning Research Centre, and Editor-in-Chief of the new Nature Partner Journal *npj Science of Learning*. Under his leadership the University is keen to deepen QBI's contributions to teaching and learning at UQ, so that more students will gain from the unique strengths of QBI staff.

These strengths are repeatedly reaffirmed by success in publications and grant applications. In 2015 Excellence in Research for Australia (ERA) rated UQ's neuroscience as "well above world standard"—the highest rating possible. This is the third consecutive top-rating for our neuroscience, in all three editions of ERA. A flawless record.

In the tough competition for major government funding, QBI staff achieved a success rate of 50 per cent for Australian Research Council (ARC) Discovery Projects applications. This compared to a national average of 17.7 per cent. For National Health and Medical Research Council Project Grants, the QBI strike rate was nearly 24 per cent, almost double the national average.

Excellent underpinning research, and significant funding, are prerequisites for positive impact. However they are not the full story. In the quest to deliver widespread benefits, our researchers are boosted by networks of collaborators and—increasingly—by partners in industry and philanthropy.

Philanthropists, most notably Chuck Feeney of The Atlantic Philanthropies, have been integral to QBI since its earliest days, and the generosity and vision of donors continues to empower QBI people to reach higher than might otherwise be possible. It is indeed fitting that a bequest from the late Maureen Gilmartin, a UQ graduate and long-term friend of the University and of QBI, is being used to seed the Bartlett Fellowship, which is named after the foundation Director. It will support talented early-career researchers who are keen to join the QBI and conduct priority research.

Commercial partnerships can also be critical for the dissemination of beneficial products of research, and in 2015 QBI made progress in two prospective commercialisation projects, one involving a therapeutic and the other a medical device.

The Institute also continued to strengthen international collaborations. For instance it hosted its third joint symposium with the Munich Center for Neurosciences, and deepened ties with Chinese researchers.

Importantly, Institute staff and students have never lost sight of the rewarding task of inspiring budding scientists. In 2015 they welcomed 140 high-school students for the Queensland final of the Australian Brain Bee Challenge, and it was a delight to see the Challenge's originator, Professor Linda Richards, become a fellow of the Australian Academy of Science. Linda was one of only 21 new fellows—from anywhere in Australia—inducted this year.

I will take this opportunity to congratulate the many QBI people who received accolades in 2015, including Perry Bartlett, who gained both a CSL Florey Medal and a Research Australia Lifetime Achievement Award.

Working alongside distinguished veterans of neuroscience surely helps motivate younger scientists—but in my experience the people of QBI need little encouragement to forge ahead. They are driven by a hunger to do good, and perhaps by the thrill of pushing the frontier in one of science's most exciting fields.

I feel honoured to lead a university with such people in its ranks, and I wish all who work and study at the QBI, as well as collaborators, partners and supporters, all power in your future endeavours.

Professor Peter Høj
Vice-Chancellor and President
The University of Queensland

Professor Pankaj Sah in front of the Queensland Brain Institute building.

QBI Director's report

IN MY FIRST report as Director, I am pleased to reflect on another outstanding year for the Institute. QBI is dedicated to studying the incredible machine that is the brain, and in 2015 has delivered significant discoveries that attest to the benefits of investing in basic research.

QBI's neuroscientific research is second to none, as evidenced by the calibre of work published in the past year. In 2015, QBI authors published nine book chapters, 11 conference papers and 273 peer-reviewed papers, with 21 of the latter appearing in *Nature* journals. QBI papers featured on the covers of *Nature*, *Science Translational Medicine*, *Trends in Neurosciences*, *Developmental Neurobiology* and twice on the cover of the *Journal of Neuroscience*.

Several of these discoveries are featured in this annual report, including the breakthrough finding by Professor Jürgen Götz's laboratory that non-invasive ultrasound technology can be used to treat Alzheimer's disease and restore memory. The discovery, which was named by Altmetric as one of the most-discussed research papers worldwide in 2015, is a testament to the fantastic work being conducted at the Clem Jones Centre for Ageing Dementia Research, and gives hope to the hundreds of thousands of Australians who are affected by Alzheimer's disease.

None of our research would be possible without the funding we receive from government grants, business partnerships and our philanthropic supporters. QBI again had a very successful year, securing a total of $28 million in competitive grant funding.

We received an additional $2.4 million in generous donations from individuals and businesses, and significantly more in commitments, for which we are extremely grateful. Many thanks must go to more than 440 supporters from whom we received donations throughout the year.

After commencing as Director, I was pleased to announce Professor Linda Richards as QBI's new Deputy Director (Research). In 2015, Professor Richards was elected as a Fellow of the Australian Academy of Sciences, and she is President-Elect of the Australasian Neuroscience Society (ANS). Both of these positions recognise the significant contribution she is making to neuroscience, especially in the field of cortical development.

Many other QBI staff members received recognition this year. Professor John McGrath was elected as a Fellow of the Australian Academy of Health and Medical Sciences. Professor McGrath is a psychiatrist whose research focusses on non-genetic risk factors for schizophrenia.

A team led by Centre for Neurogenetics and Statistical Genomics co-director Professor Naomi Wray successfully secured a $1.05 million MND Australia Ice Bucket Challenge Grant, which will fund a consortium to better understand the causes of sporadic motor neuron disease. Professor Wray was also promoted to NHMRC Principal Research Fellow in 2015, and her co-director Professor Peter Visscher was awarded an NHMRC Senior Principal Research Fellowship.

The Science of Learning Research Centre (SLRC) has made significant inroads into education research, and a major goal for 2016 is to raise money to support the centre. The SLRC has grown to more than 100 members nationwide, and a 2015 highlight was the Nature–Science of Learning Symposium held in April, which was well attended by educators, researchers and policy-makers. In 2016, we are very excited to publish the first batch of content of the *npj Science of Learning* journal, which is produced in collaboration between UQ and Nature Publishing Group.

In 2015, negotiations that would enable the Asia-Pacific Centre for Neuromodulation (APCN) to join QBI were finalised. Led by neurologist Professor Peter Silburn and neurosurgeon Dr Terry Coyne, the APCN has spearheaded the use of deep brain stimulation to treat conditions including Parkinson's disease, epilepsy and post-stroke disorders. I look forward to the exciting research that 2016 will bring.

I would like to thank QBI's founding Director, Professor Perry Bartlett, for his leadership and investment in QBI since its inception in 2003. While Professor Bartlett has stepped down as Director, he remains the leader of an active research group.

Congratulations are also in order, as in 2015 Professor Bartlett received both the prestigious CSL Florey Medal and the Research Australia Lifetime Achievement Award, both of which recognise his significant lifetime achievements in neuroscience research.

In closing, I would also like to extend my thanks to Vice-Chancellor and President Professor Peter Høj, and Provost and Senior Vice-President Professor Max Lu for their support of my appointment as QBI's second Director.

Many thanks again for your support,

Professor Pankaj Sah
Director, Queensland Brain Institute

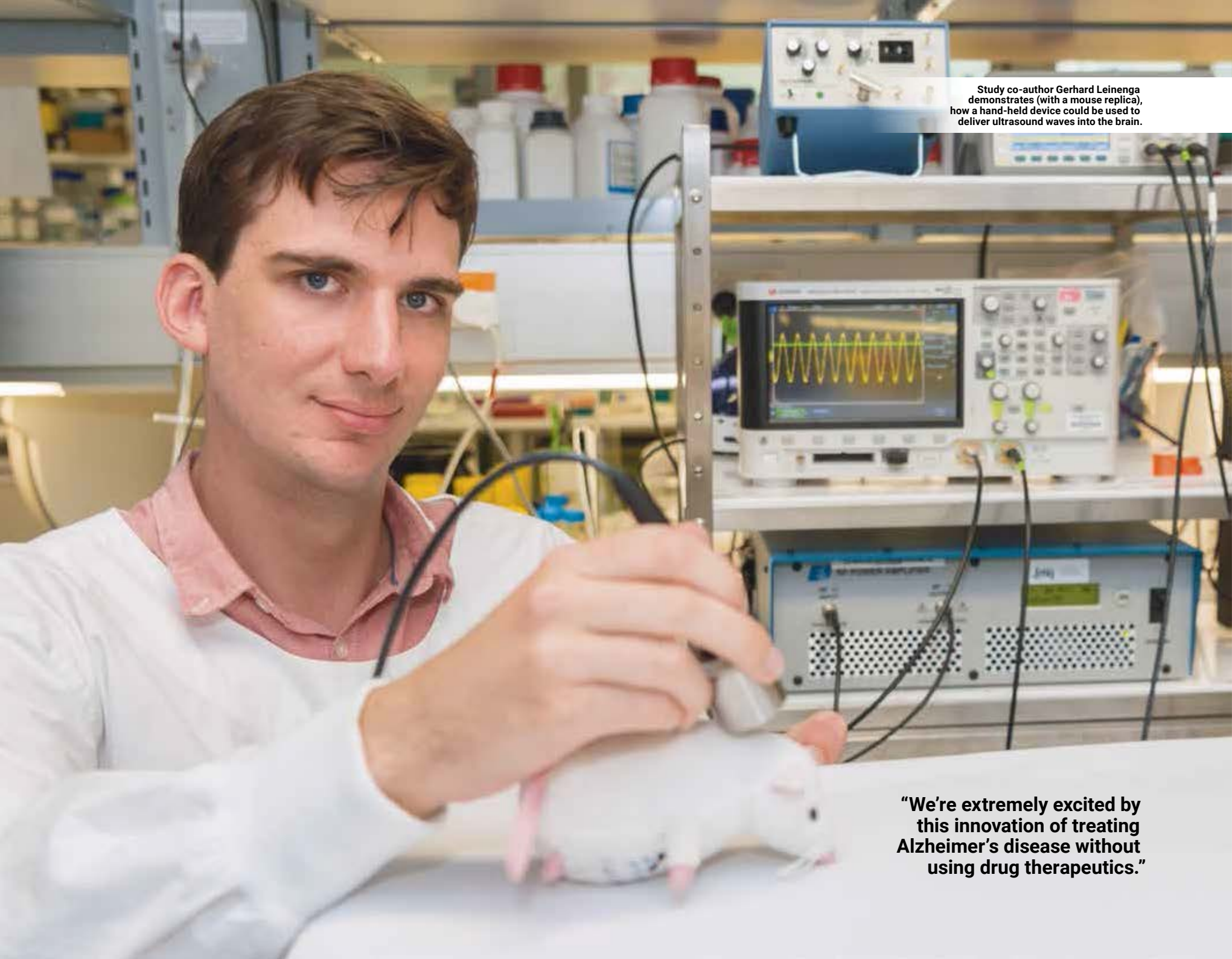
Professor Jürgen Götz welcomes the Queensland Premier, The Hon Annastacia Palaszczuk MP, ahead of a major research announcement regarding Alzheimer's disease.

Major developments

QBI continues to conduct world-leading research.

QBI developments range across the spectrum, from bench to bedside, and have implications for improving human health, innovation and understanding of the brain.

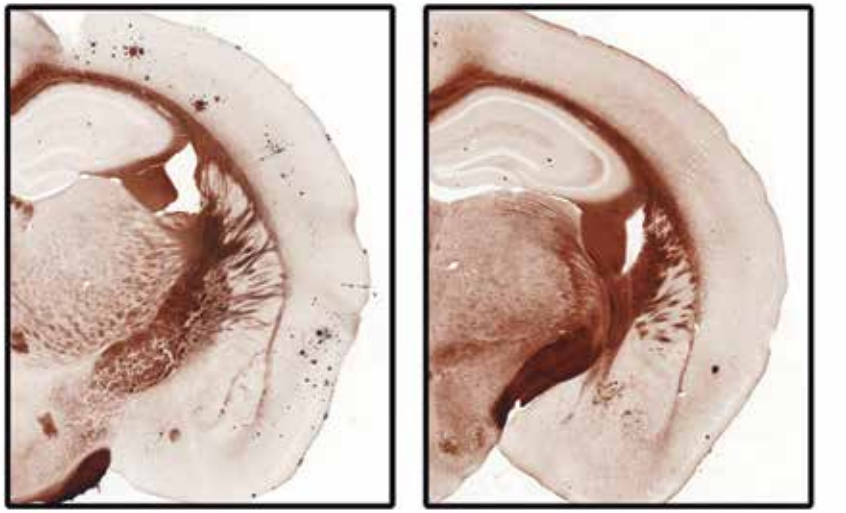
Here, we celebrate some of the major developments attained by QBI scientists in 2015.



Study co-author Gerhard Leinenga demonstrates (with a mouse replica), how a hand-held device could be used to deliver ultrasound waves into the brain.

"We're extremely excited by this innovation of treating Alzheimer's disease without using drug therapeutics."

Alzheimer's breakthrough uses ultrasound technology



In an international breakthrough, QBI scientists at the Clem Jones Centre for Ageing Dementia Research (CJCADR) found that non-invasive ultrasound technology can be used to treat Alzheimer's disease and restore memory.

CJCADR DIRECTOR PROFESSOR Jürgen Götz said the innovative, drug-free approach broke apart the neurotoxic amyloid plaques in the brain that resulted in memory loss and cognitive decline.

He said the new treatment method could revolutionise Alzheimer's treatment by restoring memory.

"We're extremely excited by this innovation of treating Alzheimer's without using drug therapeutics," Professor Götz said.

"The ultrasound waves oscillate tremendously quickly, activating microglial cells that digest and remove the amyloid plaques that destroy brain synapses.

"I think this really does fundamentally change our understanding of how to treat this disease, and I foresee a great future for this approach."

Alzheimer's affects more than two-thirds of dementia patients, and approximately a quarter of a million Australians.

The total number of dementia cases in Australia is expected to rise to 900,000 by 2050.

"With an ageing population placing an increasing burden on the health system, an important factor is cost, and other potential drug treatments using antibodies will be expensive," Professor Götz said.

"In contrast, this method uses relatively inexpensive ultrasound and microbubble technology which is non-invasive and appears highly effective.

The approach is able to temporarily open the blood-brain barrier, activating mechanisms that clear toxic protein clumps and restore memory functions.

"With our approach the blood-brain barrier's opening is only temporary—for a few hours—so it quickly restores its protective role."

Research has been conducted using mice with an Alzheimer's model, with the next step being to scale the research in higher animal models ahead of human clinical trials.

"This treatment restored memory function to the same level of normal healthy mice," Professor Götz said.

"We're also working on seeing whether this method clears toxic protein aggregates in neurodegenerative diseases other than Alzheimer's and whether this also restores executive functions, including decision-making and motor control."

The research findings were published in the journal *Science Translational Medicine*.

Above left: Amyloid plaques present in the brains of an Alzheimer's disease mouse model (left panel) are reduced by ultrasound treatment (right panel).

Professor Peter Silburn using live-feed imaging during deep brain stimulation implantation surgery.

“Integrating research into the clinical setting helps us learn more about the brain, leading to improved delivery of healthcare and better health outcomes.”

The Asia-Pacific Centre for Neuromodulation

QBI has joined forces with the Asia-Pacific Centre for Neuromodulation (APCN) to boost the translation of research findings into the clinic.

APCN WAS FOUNDED in 2012, as a joint initiative of The University of Queensland and St Andrew's War Memorial Hospital, to develop better and more cost-effective therapies for a range of neurological disorders.

In January 2016 APCN officially joined QBI, in a sign of their joint commitment to the integration of research, education and clinical care for the greatest human benefit.

QBI Director Pankaj Sah said APCN was an Asia Pacific research leader in neuromodulation treatment.

"APCN builds on two decades of ground-breaking clinical research into the use of deep brain stimulation to treat Parkinson's, among other conditions," Professor Sah said.

"APCN brings together researchers from very different backgrounds to work together towards a single goal: to improve quality of life.

"The lead clinicians, Professor Peter Silburn and Associate Professor Terry Coyne, are central to APCN's success, having performed more than 800 deep brain stimulation (DBS) procedures.

"They're committed to following through research from building-block scientific discovery to new treatments.

"We welcome them and their team of 12 scientists and students to QBI, and look forward to working alongside them," he said.

Current APCN research programs include:

- Remote monitoring of people with Parkinson's disease using GPS to measure quality of life, and personalisation of treatments.
- Inserting first in-human "sense and respond" DBS devices in patients with treatment-resistant obsessive compulsive disorder (OCD). This trial is one of the first of its kind in the world.
- Testing next-generation stimulation and recording devices to improve the design and functionality of new DBS devices.

Professor Sah also noted APCN's commitment to educating the community and the next generation of scientists and clinicians.

"Most of the DBS clinicians in Australia were trained by Peter and Terry.

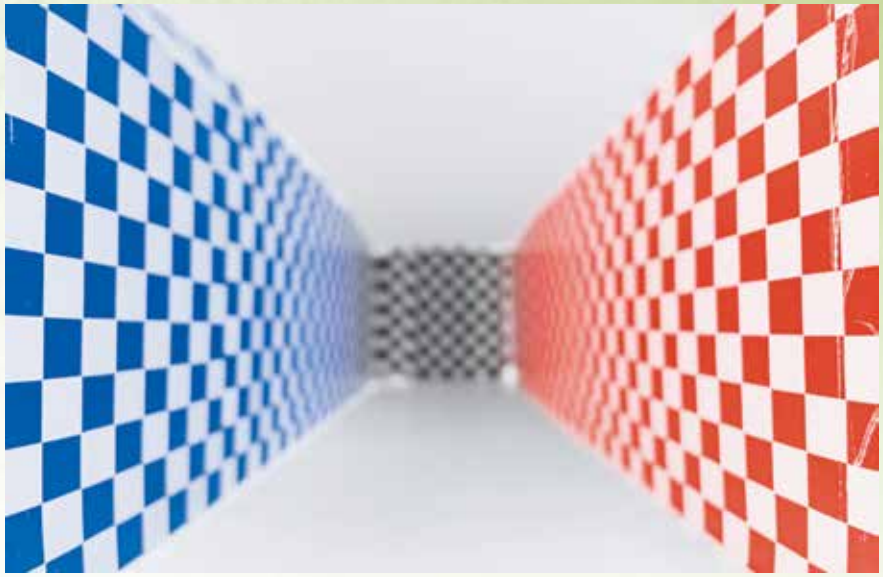
"We encourage APCN to play a role in our vibrant seminar series, sharing their work with scientists and the public," he said.

Above left: Dr Peter Poortvliet demonstrates tools used by researchers to study movement at an APCN-hosted National Science Week public lecture.

Dr Ingo Schiffner studies how birds navigate through patterned environments to understand how they regulate flight speed.

"By mimicking birds, we can look at developing systems that can more easily adapt to different speeds and conditions such as landing, cruise and take-off."

Learning about the birds and the bees helps aid flight



Research into how birds and bees use vision in flight is guiding the design of future autopilots and unmanned aerial vehicles.

A QBI STUDY shows that the humble budgerigar uses visual cues to judge and adjust its airspeed.

Researcher Dr Ingo Schiffner said understanding how speed control worked in birds could lead to the design of more flexible aircraft systems.

"By mimicking birds, which have similar flight constraints as planes, we can look at developing systems that can more easily adapt to different speeds and conditions such as landing, cruise and take-off," Dr Schiffner said.

The team conducted more than 500 flights under various conditions to see how well birds adjusted their speed to imposed changes in optic flow.

Optic flow is the apparent speed of an image in the surrounding environment that birds experience in their eyes.

Budgies flew down a long tunnel lined with projectors displaying moving patterns to make the birds believe they were flying either faster or slower than they actually were.

"We wanted to see if birds, like honeybees, control the speed of their flight by regulating the optic flow," Dr Schiffner said.

"When we moved the pattern in the same direction as their flight, this would reduce the apparent speed of the environment, and thus cause them to fly faster to compensate.

"In the most extreme case, the birds increased their air speed by about 50 per cent when the pattern was moved in their flight direction at a high speed.

"However, the opposite did not occur. When the patterns moved against the direction flight, the birds barely reduced their flight speed.

"We think this asymmetry is due to the aerodynamic and energy constraints that birds experience in flight."

QBI's Professor Mandyam Srinivasan said comparative studies of honeybees and birds could be applied to future autopilots for commercial planes or unmanned aerial vehicles.

"The current generation of biologically inspired unmanned aerial vehicles is derived from insect vision, and is most applicable to helicopter-like aircraft," he said.

"However, the bird research may be more readily applicable to fixed-wing aircraft, because bird flight is more like the flight of a fixed-wing aircraft than a helicopter," he said.

The research was published in the Nature journal *Scientific Reports*.

Above left: Chequered tunnels are used to observe honeybee flight.

L–R: Dr Rosina Giordano-Santini, Dr Sean Coakley and Casey Linton contributed to the discovery published in the prestigeous journal *Nature*.

"The moment there is a cut to the nerve, there is a change in the membrane composition, which acts as a signal to the other part of the nerve, saying 'I am in danger, come save me.' "

Nerve regeneration mechanism unlocked

A small transparent roundworm with the remarkable ability to self-heal may hold the secret to treating nerve injuries in humans.

IN 2015, QBI scientists discovered the molecular mechanisms that allow severed nerves in roundworms to fuse back together.

Project leader Associate Professor Massimo Hilliard said the findings provided hope for treating nerve injuries.

"This will now open new avenues to try to exploit this knowledge in other systems closer to human physiology, and hopefully move further towards solving nerve injuries," he said.

"We'll now try to understand if a similar process occurs in vertebrates and, if it doesn't, how we can use what we have learned from worms to make it happen and then scale it up towards humans."

Dr Hilliard said neurosurgery could be combined with molecular biology in the future to deliver clinical outcomes, and perhaps treat conditions such as spinal cord injury or vascular damage where healthy neurons were injured.

"Neurosurgery alone to fix nerve injuries by effectively trying to stitch together broken nerves has had limited success," he said.

"But a combined approach using molecular biology might create an environment that is much more conducive for regeneration, and we may be able to deliver molecules that act as a glue to enable healing."

Nerve injuries can take on many forms, from temporary to permanent, and can involve impaired function for abilities such as sensory or motor control.

Research paper lead author Dr Brent Neumann, also from QBI, said the *C. elegans* roundworm was an ideal model for studying the nervous system.

"We study the roundworm species *C. elegans* because its transparency, simplistic structure, and known genetics allow us to easily understand the processes that occur inside its body," he said.

"This meant we were able to progress rapidly, and go from a description of what happens, to understanding the very process of how it happens on a genetic and molecular level."

Professor Ding Xue, from collaborating partner the University of Colorado, Boulder, who first discovered some of the molecules used in the study, said knowledge of them helped the researchers understand the regenerative mechanism.

"The moment there is a cut to the nerve, there is a change in the membrane composition, which acts as a signal to the other part of the nerve, saying 'I am in danger, come save me,'" Professor Xue said.

"This is really interesting, because it resembles another biological process in humans called apoptosis, when a cell is dying and it changes the membrane composition and marks the cell for quick removal."

The research was funded by the National Health and Medical Research Council, the Australian Research Council and the National Institutes of Health, and was published in the journal *Nature*.

Above left: Dr Brent Neumann (left) is lead author, and Associate Professor Massimo Hilliard (right) is senior author on the *Nature* publication.

Professor Justin Marshall (right) and Sir David Attenborough (left) explored the Great Barrier Reef in a yellow submarine. Photo courtesy of Atlantic Productions.

"To sit side by side with Sir David Attenborough in a submersible at 300m and help interpret the natural history of the Great Barrier Reef was a biologist's dream come true."

Diving with the stars

In 2015 the head of QBI's sensory ecology laboratory, Professor Justin Marshall, worked with Sir David Attenborough on a documentary series about the Great Barrier Reef.

HAVING PROVIDED INPUT on the *First Life* documentaries with Sir David about five years ago, Professor Marshall's new role was as chief co-ordinating scientist on *Sir David Attenborough's Great Barrier Reef*, a three-part television series to be screened on the ABC in April 2016.

This included a 10-day exploration and filming expedition aboard the MV *Alucia*. The cutting-edge research vessel and its submersibles were used to take Attenborough back to an environment he first visited as a scuba diver almost 60 years ago. Professor Marshall said that working with Attenborough, the greatest interpreter of the natural world, was a great privilege. "To sit side by side with Sir David Attenborough in a submersible at 300m and help interpret the natural history of the Great Barrier Reef (GBR) was a biologist's dream come true," he said.

Along with other researchers at UQ, several new discoveries from Professor Marshall's neuroscience research were picked up by Attenborough for this series. These included the complex vision of mantis shrimps and colour communication in reef systems. This research, including the use of polarised light, has applications for medical and engineering technologies.

Attenborough acknowledged Professor Marshall's expertise on mantis shrimps, which featured in the TV series.

"Mantis shrimps have different adaptations but they also have an extraordinarily complex visual system which we are only just beginning to understand and fortunately Justin—who's a great expert on mantis shrimps—was our chief scientific advisor," he said.

Professor Marshall said that one of his jobs during the shoot was to fact check the science David presented.

"He is totally committed to getting the facts right and where my knowledge failed, I could point David and the team to other scientists I knew would have the answers," Professor Marshall said.

Professor Marshall was also present in the Triton Submarine when David completed a dive that was filmed in virtual reality (VR). This finished VR experience has been playing to sell-out crowds at London's Natural History Museum and will open in April 2016 in the Australian Museum in Sydney. Professor Marshall also provided scientific content for the interactive website to accompany this project which launched in December 2015 at www.attenboroughsreef.com.

"It was fantastic to use this science platform for its original purpose, to go places deeper than anyone has been before off the Great Barrier Reef and to film and share this information through Sir David and Atlantic Productions," Professor Marshall said. "Let's hope that we can ensure the wonders of our reef will be here for future generations, not just on film." As part of this effort, Professor Marshall started CoralWatch 12 years ago, a citizen-science program also aimed at interpreting the changes we are seeing on the reef and exploring ways to keep the reef for future generations.

MV *Alucia*, the research vessel used by Atlantic Productions, is owned by Ray Dalio, a generous contributor to research at UQ. The ship and submersibles, however, comprised a high-end science support vessel for an Australian Research Council Linkage project. Headed by Professor Marshall, The Deep-Australia Project is a partnership with Australian explorer Mike McDowell.

Above left: *Odontodactylus scyllarus*, a species of mantis shrimp that Professor Justin Marshall studies. Photo by Roy Caldwell.

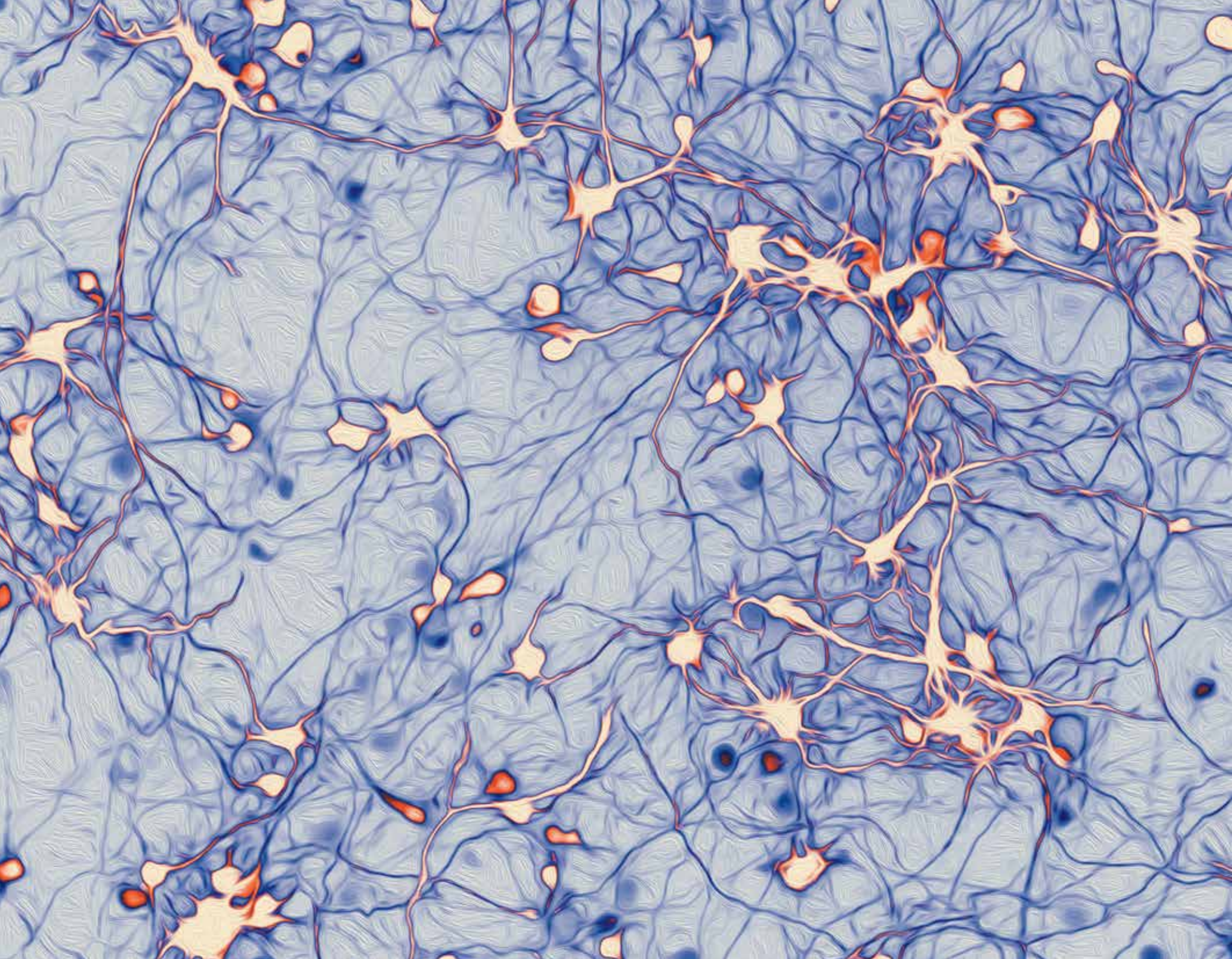

Imager.Z2

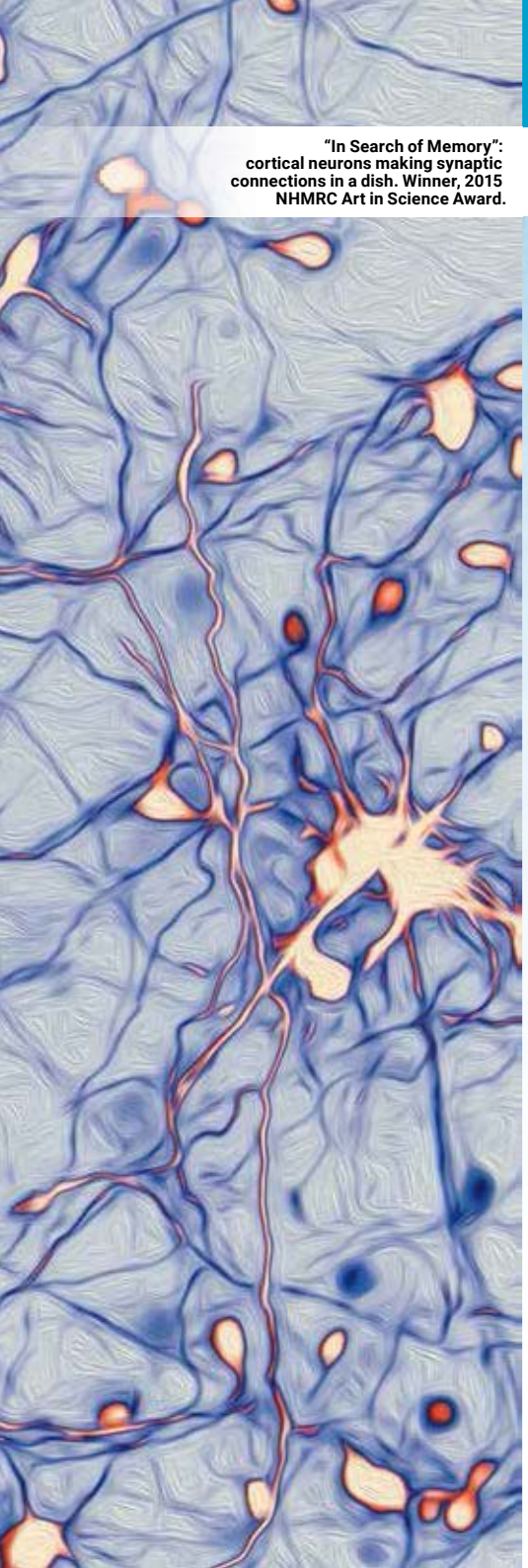
In 2015, Dr Steven Zuryn was appointed as the Stafford Fox Senior Research Fellow.

Research groups

QBI scientists study brain processes, disorders and diseases that have relevance from early development through to later life.

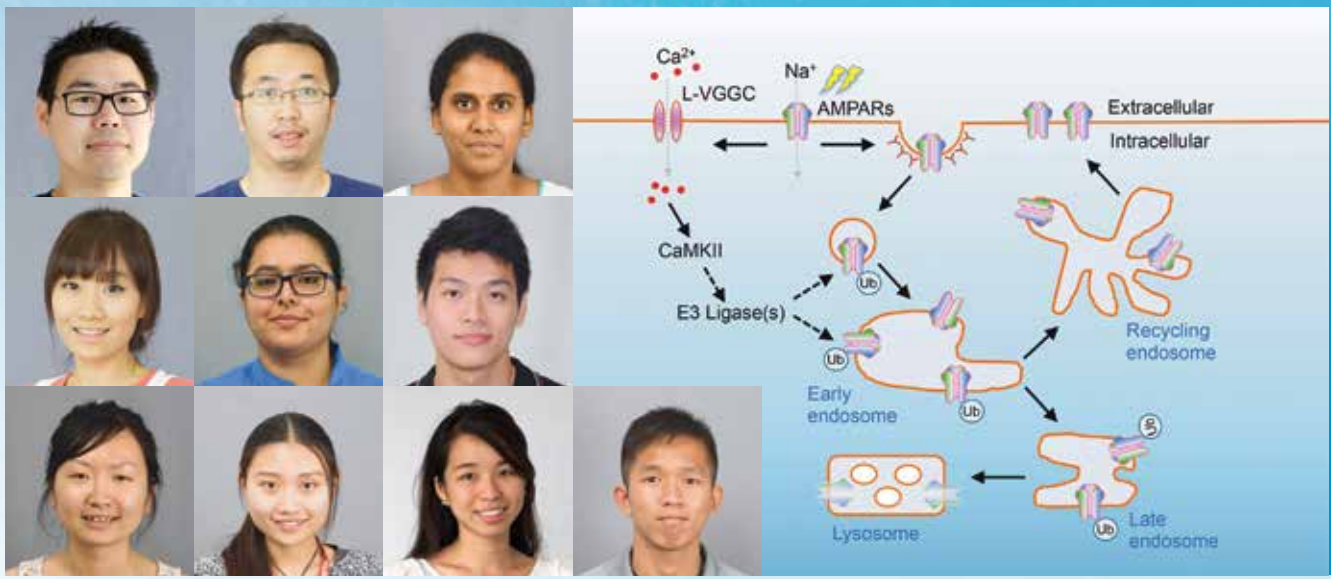
2015 was another outstanding year for QBI, with our scientists in 35 laboratories producing world-class research.





"In Search of Memory": cortical neurons making synaptic connections in a dish. Winner, 2015 NHMRC Art in Science Award.

Laboratory head **Dr Victor Anggono**



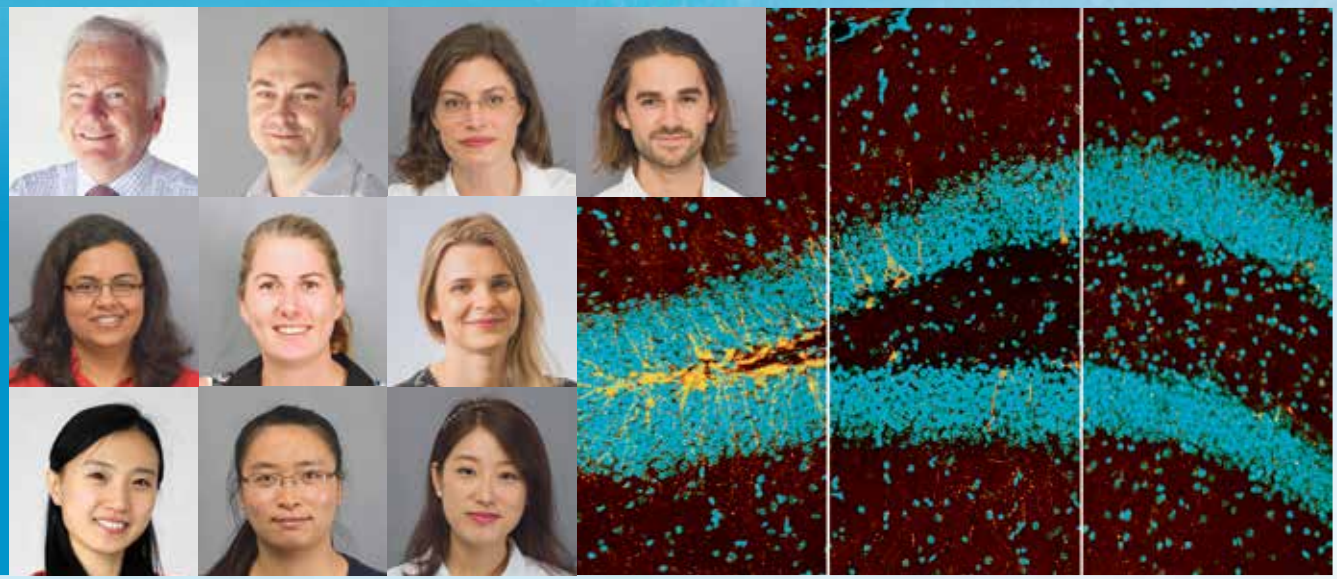
2015 laboratory members L–R/T–B: Victor Anggono, Yu Qian Chau, Sumasri Guntupalli, Se Eun (Joanne) Jang, Simran Kaur, Daniel Lim, Men Chee Tan, Chenxi (Tracy) Wang, Jocelyn Widagdo, Desmond Woo. **Image:** Proposed model for the role of protein ubiquitination in mediating AMPA receptor intracellular endosomal sorting.

Mechanisms underlying glutamate receptor turnover

AMPA-type glutamate receptors are essential for excitatory synaptic transmission in the mammalian central nervous system. The ability of neurons to modulate the strength of their connections, termed synaptic plasticity, is determined in part by the number of these receptors at synapses. Dysregulation of AMPA receptor trafficking results in an imbalance in neuronal excitation and inhibition, which often results in the memory impairment and cognitive deficits associated with various neurological disorders, such as Alzheimer's disease, schizophrenia, bipolar disorders and autism. The major aim of the Anggono group is to understand the detailed molecular mechanisms regulating AMPA receptor trafficking, synaptic plasticity, learning and memory.

In 2015, the Anggono group discovered that all four AMPA receptor subunits (GluA1-4) undergo post-translational ubiquitination in an activity-dependent manner. They mapped the sites of ubiquitination to specific lysine residues in the carboxyl-terminal tails of GluA1 and GluA2 subunits. Mutation of these lysine residues inhibits AMPA receptor ubiquitination, subsequently leading to mis-sorting of AMPA receptors from late- to recycling-endosomes. As a consequence, these mutant AMPA receptors escape the degradation pathway and are more stable in neurons. This study, which was published in the journal *Cell Reports*, has wide-ranging ramifications, including for our understanding of several neurological disorders by which AMPA receptors are aberrantly degraded, such as Alzheimer's disease and schizophrenia. This paper was recommended by the *Faculty of 1000* and formed the subject of invited seminars at the 25th Meeting of the International Society for Neurochemistry (Cairns, Australia) and the 14th Federation of Asian and Oceanian Biochemists and Molecular Biologists Congress (Hyderabad, India). Work in the Anggono laboratory was supported by project grants from the NHMRC and the Alzheimer's Australia Dementia Research Foundation.

Laboratory head **Professor Perry Bartlett**



2015 laboratory members L–R/T–B: Perry Bartlett, Daniel Blackmore, Lavinia Codd, Samuel Harley, Dhanisha Jhaveri, Imogen O'Keeffe, Jana Vukovic, Jing Zhao, Mei Zhou, Xiaoqing (Alice) Zhou. *Not pictured:* Richard Wang, Weichuan Mo (based in China). **Image:** Photomicrographs from 10-week-, 12-month- and 24-month-old mice juxtaposed to show the decrease in DCX+ve cells (new neurons) during the course of ageing.

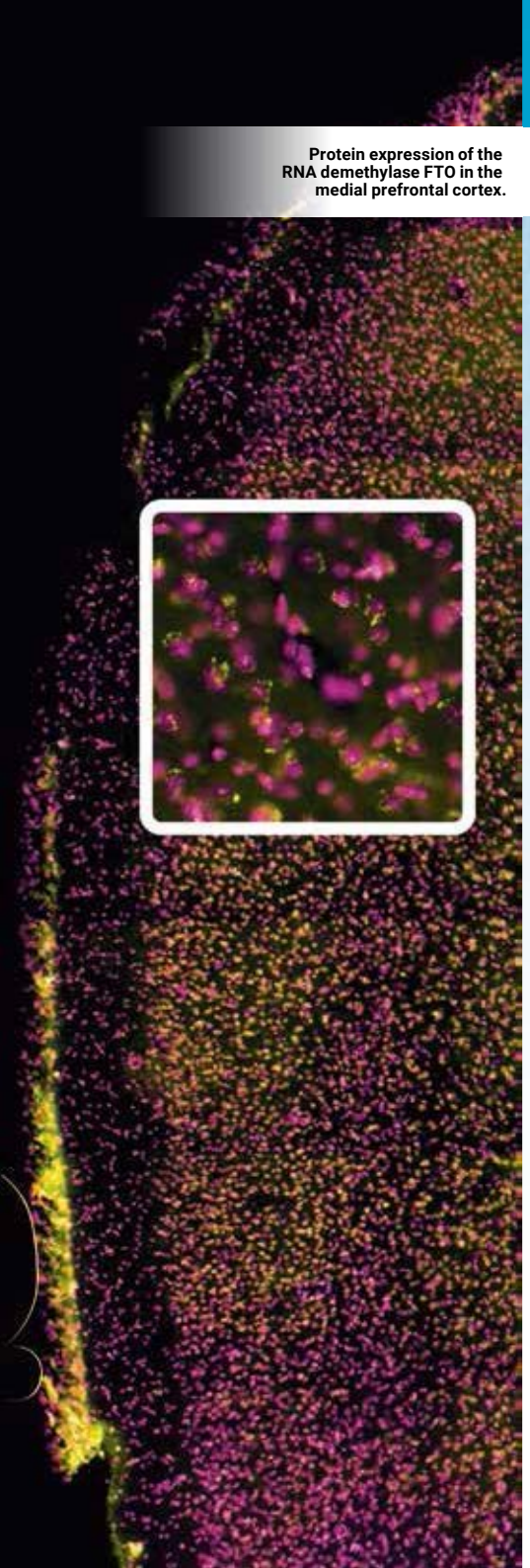
Understanding the regulation and function of hippocampal neurogenesis

Professor Perry Bartlett's laboratory is focussed on understanding the mechanisms that regulate the production and function of new neurons, generated from the resident population of stem/precursor cells in a region of the adult brain known as the hippocampus. This process, called neurogenesis, declines with age, and this loss of new neurons has been associated with impairments in cognitive function as well as mood. The group has discovered that the majority of these stem cells are quiescent, but that they can be activated by stimuli as diverse as physical exercise, antidepressants, and learning.

The Bartlett group is now focussed on identifying the molecular mechanisms that regulate stem cell activation, and on using this knowledge to enhance neurogenesis and ameliorate functional deficits in mouse models of ageing dementia, stroke, anxiety and depression.

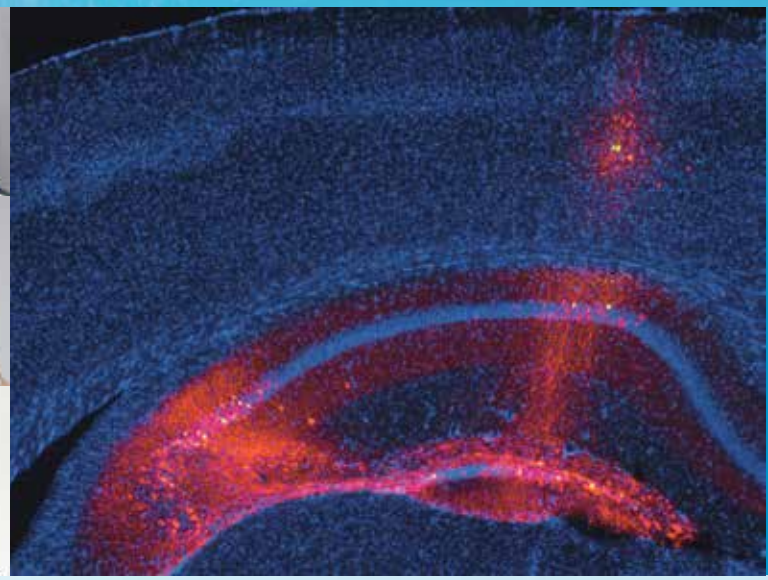
In a study that was featured on the front cover of the *Journal of Neuroscience* (Jhaveri *et al.*), the Bartlett laboratory reported development of a new cell-sorting method to purify, for the first time, hippocampal stem precursor cells to near homogeneity. The study examined the responsiveness of individual precursors to various stimuli and provided the first evidence for the presence of two distinct subpopulations of quiescent precursors in the hippocampus. The study further showed that these distinct precursors are located in different regions of the hippocampus and generate neuronal progeny that are molecularly different. Since it has been shown that neurons regulating spatial learning and those regulating anxiety and mood are located in different areas of the hippocampus, it suggests that it is the preferential activation of one of the two distinct precursor populations that may underpin the different functions of the hippocampus.

"Real" stem cells in the hippocampus of an adult mouse; identified by the presence of EGF receptor on their cell surface (black dots). Image by Dhanisha Jhaveri.



Protein expression of the RNA demethylase FTO in the medial prefrontal cortex.

Laboratory head **Dr Timothy Bredy**



2015 laboratory members L–R/T–B: Timothy Bredy, Danay Baker-Andresen, Chuan Yang (Michael) Dai, Laura Leighton, Xiang Li, Krista Mitchnick Vikram Ratnu, Jenny Wang, Wei Wei. *Not pictured:* Srjana Kishore. **Image:** Piwil shRNA infused into the dorsal hippocampus.

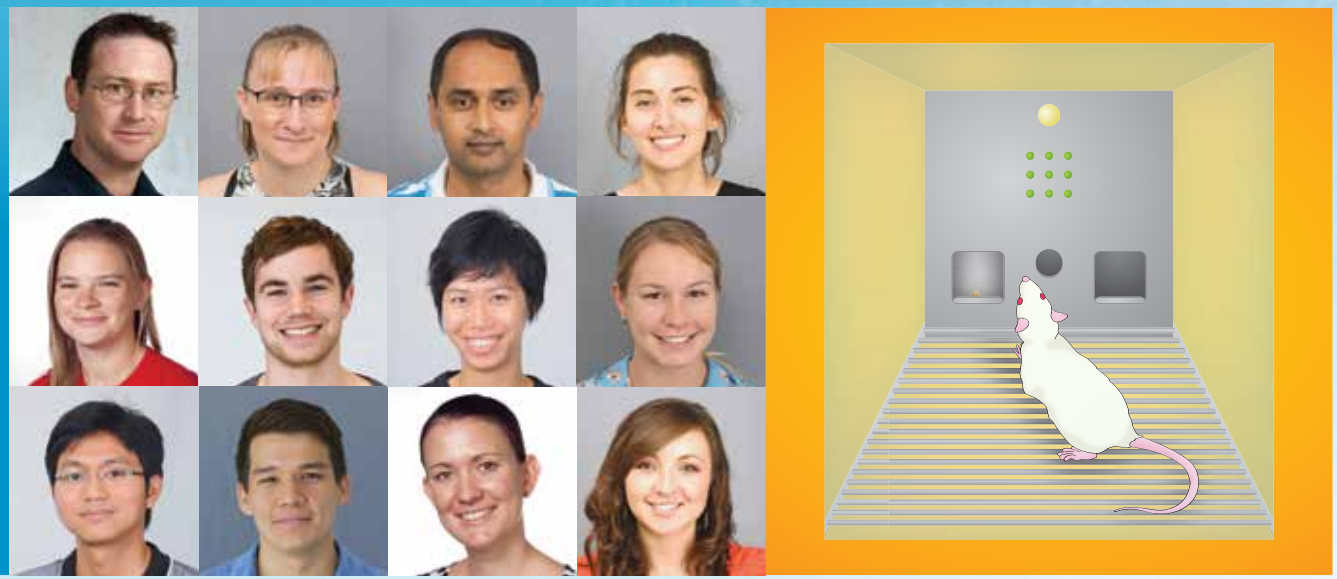
Epigenetic mechanisms regulating memory

The extinction of conditioned fear (the reduction in response to a feared cue when the cue is repeatedly presented without any adverse consequence) is an important model for the treatment of anxiety disorders. Like other forms of learning, long-lasting memory for fear extinction depends on co-ordinated gene expression and the synthesis of new synaptic proteins. This process involves a tightly controlled interplay between transcriptional machinery and enzymes that regulate chromatin structure, a relatively recent field of research referred to as epigenetics.

Research in the Bredy laboratory is elucidating how the genome is connected to the environment through epigenetic modifications, and how this relationship shapes behaviour throughout life. The group is particularly interested in how epigenetic mechanisms, including DNA methylation, histone modifications and the activity of non-coding RNAs, regulate the formation and maintenance of memory.

It was a productive year for the laboratory, which published a ground-breaking new study on the role of long non-coding RNAs and neural plasticity in the journal *Biological Psychiatry*. In other work, which appeared in the journal *Neuroepigenetics*, the group demonstrated together with collaborators that neuron-specific changes in DNA methylation are associated with cocaine addiction. The work received significant exposure, with invited talks at several international meetings, including the Keystone conference on Neuroepigenetics and Behavioral Epigenetics at Janelia Research Campus.

Laboratory head **Associate Professor Thomas Burne**



2015 laboratory members L–R/T–B: Thomas Burne, Suzy Alexander, Md Mamun Al-Amin, Kyna-Anne Conn, Natalie Groves, Lachlan Harris, Pauline Ko, Emilia Lefevre, Aung Aung Moe, Chris Simpson, Karly Turner, Michelle Sanchez Vega. **Image:** A novel signal detection task where rodents are trained to obtain food rewards while attentional performance is measured.

Translation of cognitive tasks for animal models of neuropsychiatric disorders

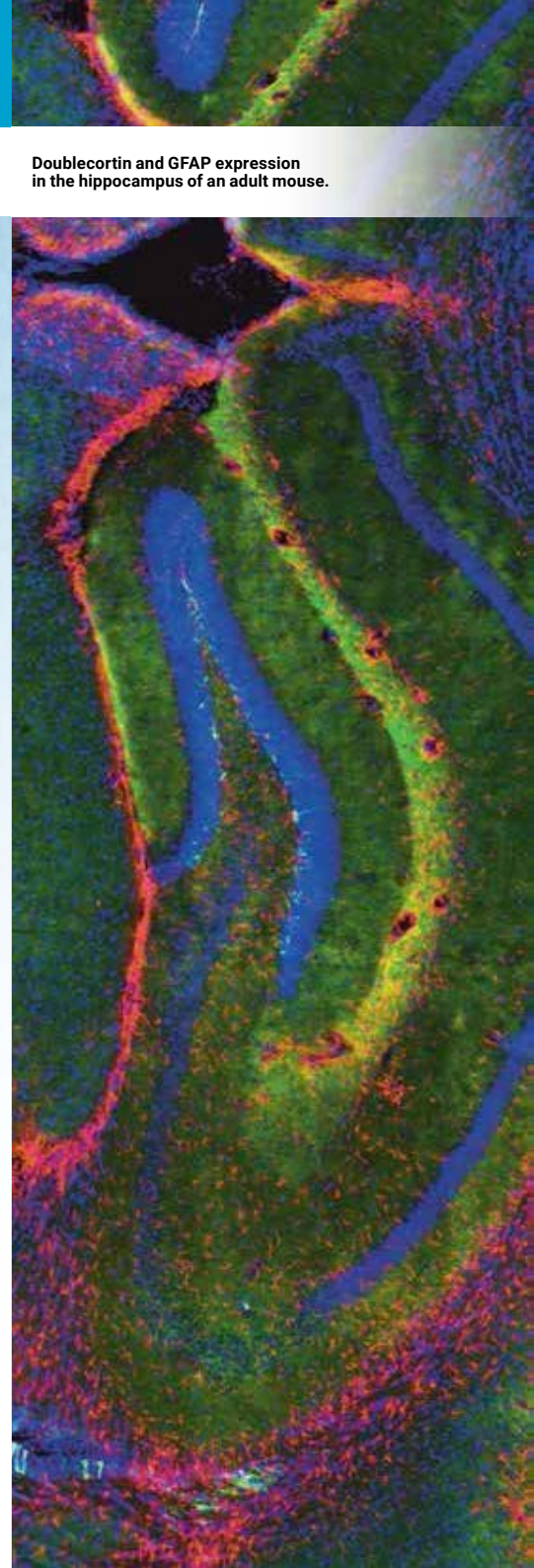
Associate Professor Thomas Burne's group studies brain development and behaviour in animal models. The group is focussed on investigating the underlying biological basis for schizophrenia, with the goal of finding public health interventions that will alleviate the burden of this disease.

The group has been exploring the impact of developmental vitamin D deficiency on brain development, the impact of adult vitamin D deficiency on brain function and behaviour and, more recently, has been establishing novel ways to assess cognitive behaviour in rodents.

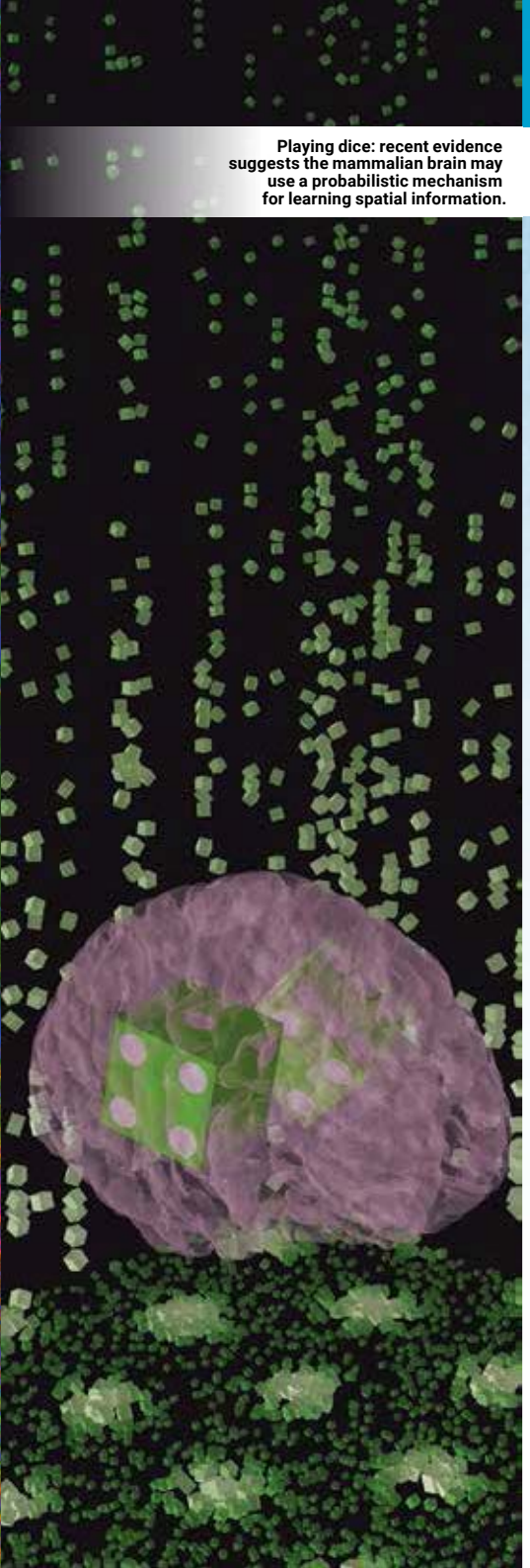
In 2015, the Burne group built on previous research on low prenatal vitamin D (the "sunshine hormone") to show that adult vitamin D deficiency is also associated with alterations in behaviour, brain neurochemistry and receptor profiles. They have discovered that low vitamin D levels during adulthood affect the balance of excitatory and inhibitory neurotransmitters in the brain, and also alter cognitive behaviour in rodents. These results provide the first evidence in mice to show that adult vitamin D deficiency impacts on neurotransmitter systems that are affected in a number of neuropsychiatric conditions, including autism, schizophrenia and depression.

Ongoing NHMRC funding allows the group to dissect the exact neural pathways involved in cognitive impairments of attentional processing in vitamin D–deficient animals to model the cognitive symptoms of schizophrenia.

The Burne group has also created and validated a unique cognitive task for rodents that mirrors the continuous performance task in humans. The group's goal is to provide a novel tool for cognitive research in rodents and to uncover more about the pathophysiology and drug treatment of cognitive symptoms in schizophrenia.

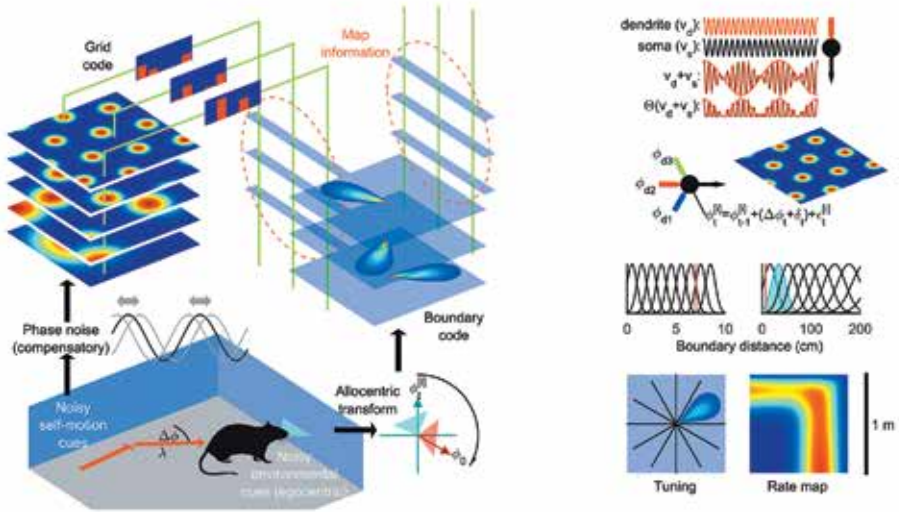


Doublecortin and GFAP expression in the hippocampus of an adult mouse.



Playing dice: recent evidence suggests the mammalian brain may use a probabilistic mechanism for learning spatial information.

Laboratory head **Dr Allen Cheung**



2015 laboratory members T–B: Allen Cheung, Chris Nolan. *Not pictured:* Vinay Chandragiri, Zoltán Kósci, Adam Luff. **Image:** Bridging cells, systems and computations: a new computational model can probabilistically combine information encoded by two known cell types (grid and boundary cells), able to learn under realistic levels of sensory uncertainty.

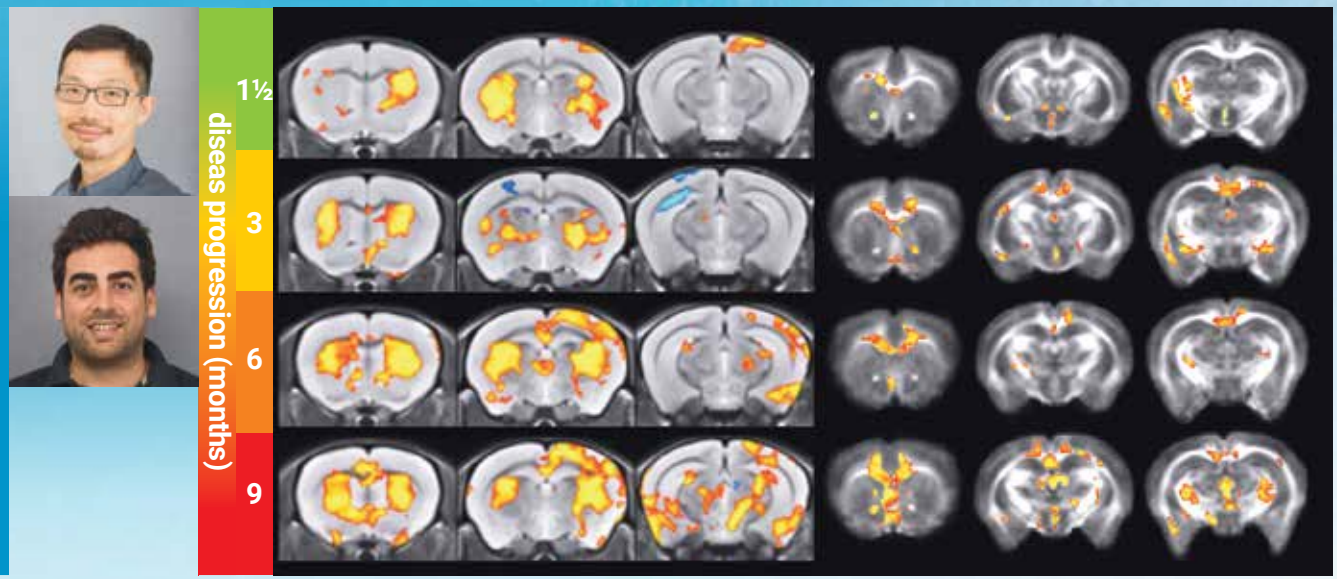
Understanding spatial computations in the mammalian brain

The core research of the Cheung laboratory is aimed at understanding the fundamental brain computations required for spatial navigation. Spatial navigation is one of the oldest and most widespread brain functions in the animal kingdom. The cells, circuits and computations required for animals to search for resources, return home, and go back to those resources later are subjects of intense research worldwide.

The 2014 Nobel Prize in Physiology or Medicine was awarded to three scientists who made seminal contributions to the identification and characterisation of cells in the rat brain that encode space (e.g., grid cells and place cells). Despite this significant milestone, a great deal remains unknown about the computations that underlie mammalian spatial representations. By developing a new spatial information fusion model and comparing it to published neuronal recordings in navigating rats, the Cheung laboratory recently found that diverse response patterns of spatial cells, called "grid cells", are consistent with a single mechanism of probabilistic learning and recall. This provides the most complete explanation of grid cell function to date, and makes a number of new and testable predictions about grid cell function.

The Cheung laboratory is involved in ongoing collaborative research projects with local and international neuroscientists, including: (1) place cell recordings in rats navigating in darkness to investigate the nature of spatial memory; (2) fMRI studies to investigate how the human brain encodes space during virtual navigation; (3) human behavioural studies to look for evidence of a mental map; (4) the development of a model of place cells, which may be used for path planning; (5) understanding the computational mechanisms underlying the head direction system and its apparent independence from other spatial systems.

Laboratory head **Associate Professor Kai-Hsiang Chuang**



2015 laboratory members T–B: Kai-Hsiang Chuang, Hussein Srour. **Image:** Structural MRI (left) and diffusion tensor imaging (right) detect progressive gray matter and white matter deficits in a mouse model of Huntington's disease. Atrophy can be seen in the striatum and the corpus callosum in the pre-symptomatic stage at 1½ months old. The network pattern provides a biomarker for diagnosis and treatment efficacy.

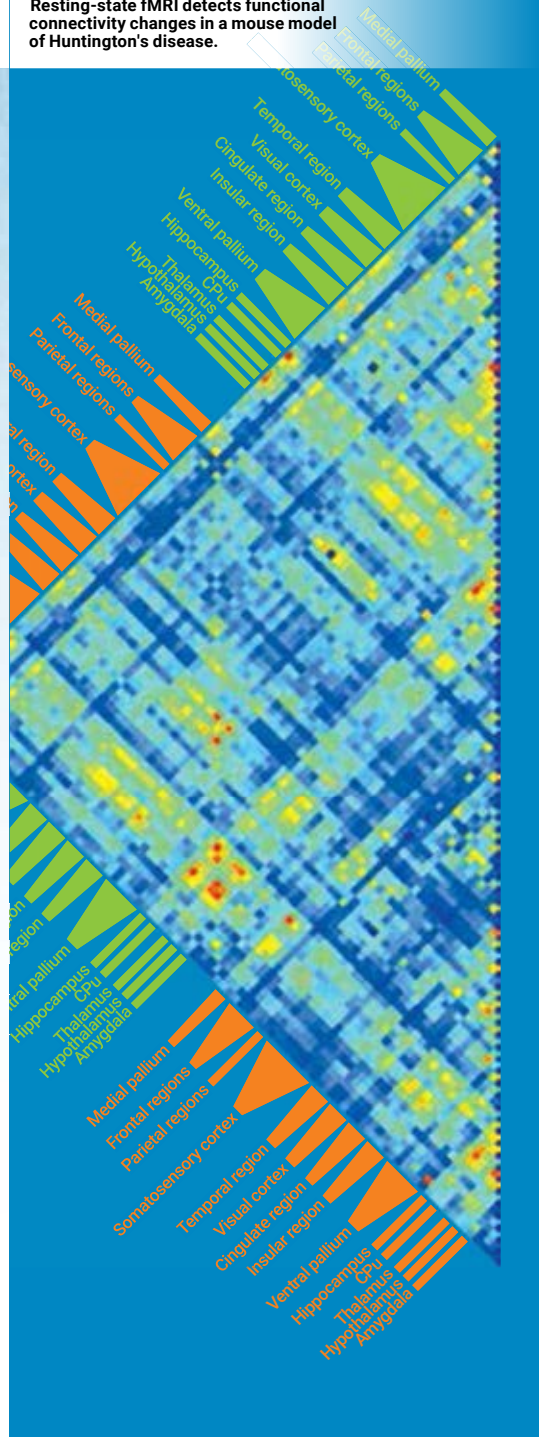
Imaging biomarkers of diseases

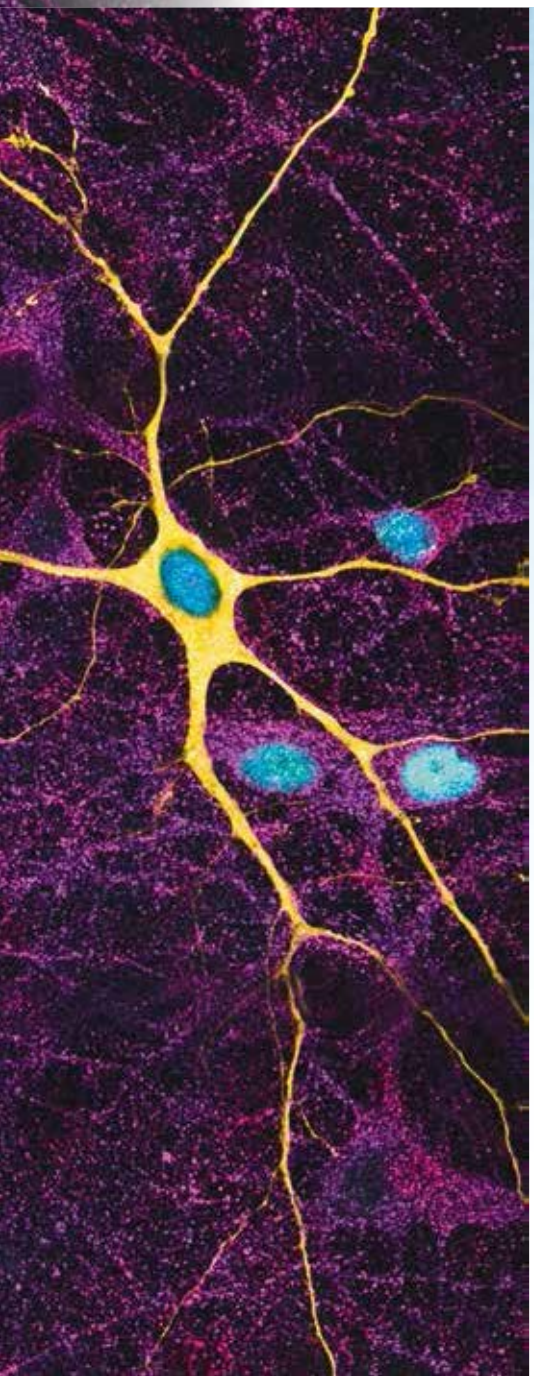
The Chuang laboratory is developing functional and molecular imaging to understand the neural endophenotypes of diseases. Identifying disease-specific patterns of brain activity and connectivity as biomarkers could improve the characterisation of diseases and their progress; the Chuang group aims to facilitate early and specific diagnosis, optimise treatment and develop drug therapeutics.

A major focus of the laboratory is to map and understand the functional connectome in vivo. The brain connectome describes how neurons are wired and interact. It is a critical component for linking behaviour with cellular and molecular changes. Many neurodegenerative and psychiatric disorders show deficits in brain networks, suggesting that disease connectomes may underlie disease progression. To determine brain connectivity associated with behaviour, the Chuang group developed manganese-enhanced magnetic resonance imaging (MRI) for in vivo staining of the hippocampus, a key region for memory, and detected plasticity in the mossy fibres after a memory task in the rodent brain (*Neuroimage* 2015).

To image large-scale memory-related networks, the group established resting-state functional magnetic resonance imaging (fMRI), a technique measuring brain synchrony, to infer functional connectivity in the rodent brain. They identified ongoing synchronous activity following a memory task and found that connectivity patterns reorganised toward the cortex over time, in line with current understanding of memory consolidation. The connectivity and behaviour performance can be enhanced by Aricept®, a drug for treating dementia. The relationship between the functional connectome and memory performance indicates the potential of fMRI for tracking cognitive function in diseases and to test drug effects. Now, the group is applying structural and functional connectivity imaging in mouse models of neurodegeneration to track disease progress and assess responses to experimental treatments.

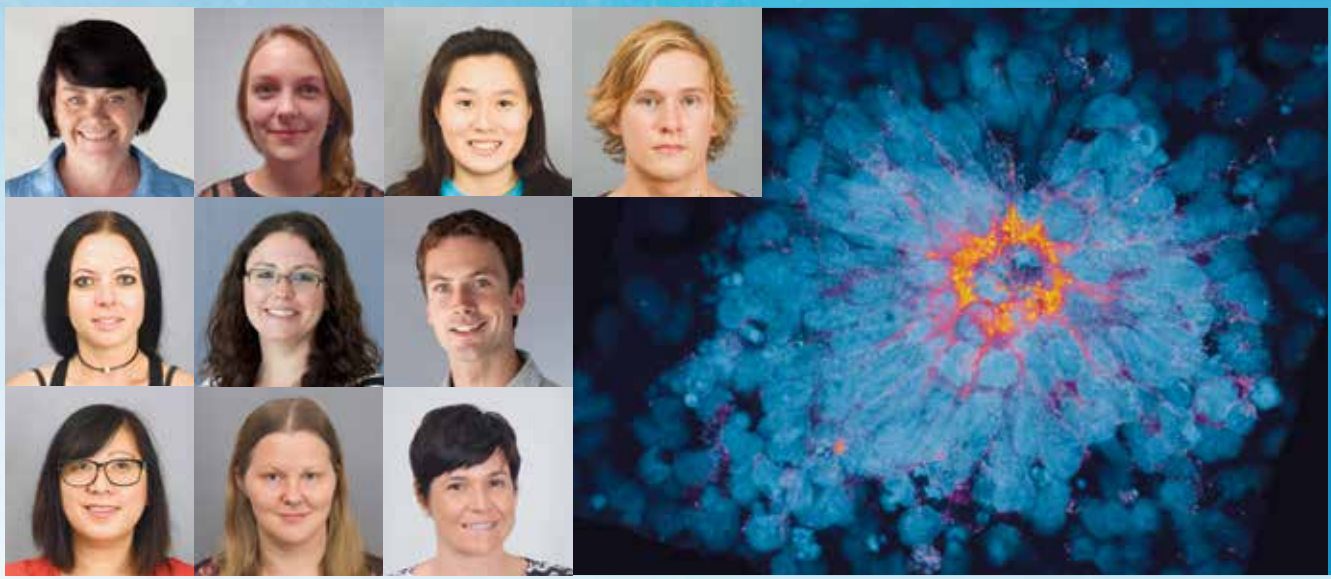
Resting-state fMRI detects functional connectivity changes in a mouse model of Huntington's disease.





PSD95 clusters (purple) on 5-day-old hippocampal neurons.

Laboratory head **Associate Professor Helen Cooper**



2015 laboratory members L–R/T–B: Helen Cooper, Lily Fogg, Ka Wai Fok, Michael Langford, Vanessa Lanoue, Natalie Lee, Conor O'Leary, Loc-Duyen Pham, Amanda White, Nicole Wilson. **Image:** Human pluripotent stem cells transform into neural stem cells (orange/pink).

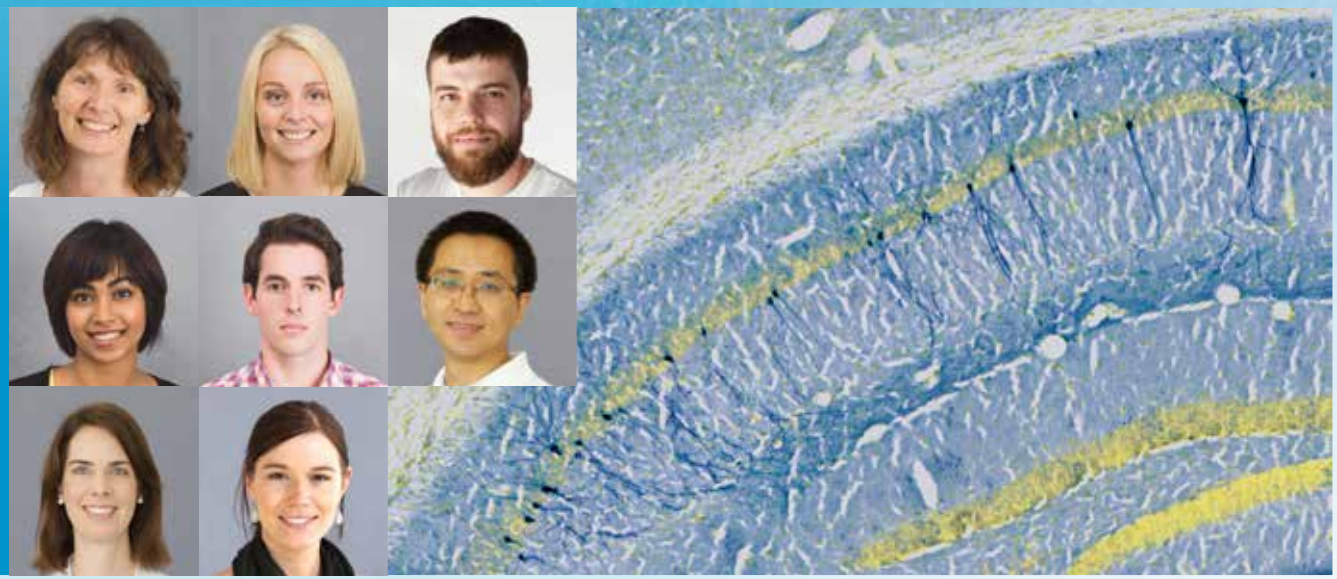
Understanding the molecular pathways building the brain

Current research in the Cooper laboratory explores the fundamental cellular and molecular mechanisms governing the development of the neocortex. The group has identified unexpected, novel roles for the axon guidance receptors Neogenin (a netrin receptor) and Ryk (a Wnt receptor) in neural stem cell biology, neurogenesis, dendrite outgrowth and synaptogenesis. The Cooper group has shown that loss of these receptors in the mouse leads to cortical malformations which are equivalent to those seen in humans.

The group's latest studies are providing a mechanistic understanding of how these signalling pathways ensure the fidelity of cortical development. The laboratory has also uncovered intriguing links between these receptors and genes associated with schizophrenia and autism. The Cooper laboratory believes that these studies will produce fundamental insights into the pathophysiology of cortical malformations and perhaps provide some clues to the molecular basis of neuropsychiatric disorders.

Importantly, to ensure that discoveries are relevant to the human brain, the group has also initiated a collaboration with Professor Ernst Wolvetang (AIBN, UQ) to investigate these signalling pathways in human induced pluripotent stem cells, which can generate embryonic neural stem cells and many neuronal subtypes found in the neocortex. In the coming years the laboratory hopes to identify new modulators of neurogenesis and neuronal connectivity. The Cooper group will also explore the functions of genes known to carry mutations that contribute to cortical malformations and neuropsychiatric disorders.

Laboratory head **Professor Elizabeth Coulson**



2015 laboratory members L–R/T–B: Elizabeth Coulson, Lacey Atkins, Zoran Boskovic, Marie Lou Camara, Michael Milne, Lei Qian, Bree Rumballe, Toni Turnbull. *Not pictured:* Nathan Hearn. **Image:** Tree-like neuronal cells (dark blue) are typical of neurons located in the hippocampus (yellow).

Understanding the aetiology of neurodegenerative disease

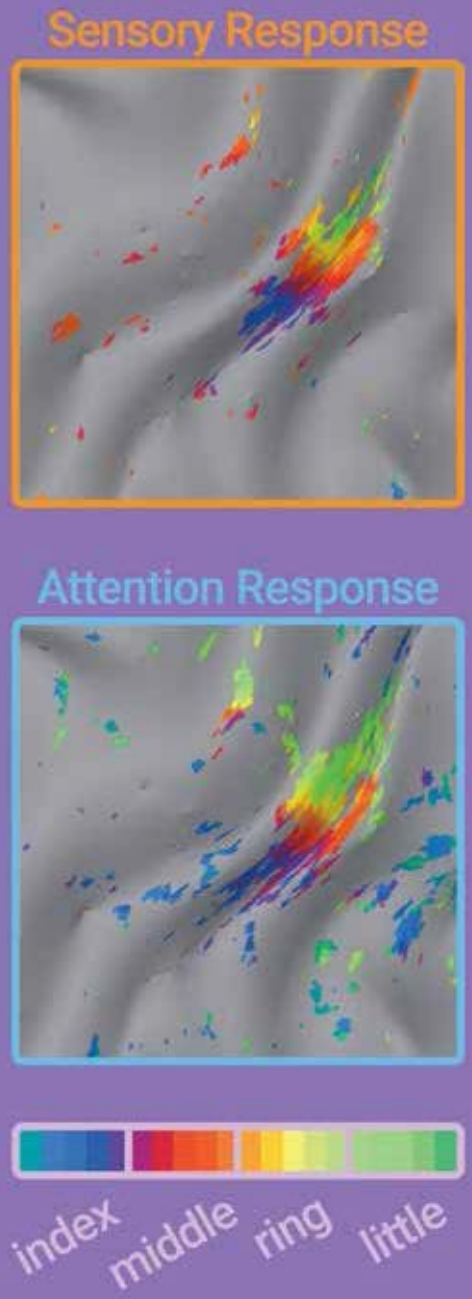
The Coulson laboratory is investigating how and why certain neurons die in neurodegenerative diseases including Alzheimer's disease (AD) and motor neuron disease (MND). Their work focusses on the p75 neurotrophin receptor ($p75^{NTR}$) and its role in neuronal loss, particularly the nerve cell degeneration that occurs in cholinergic neurons in the brain and spinal cord.

Cholinergic neurons in the basal forebrain are important for learning and memory, and post-mortem studies show that they can be selectively lost in AD. The current treatment for AD patients targets the function of these cholinergic neurons. However, significant loss of these neurons has already occurred in the majority of AD patients prior to treatment, and because these drugs are only efficacious while the neurons are alive, these treatments are of limited value to most patients. Better drugs are needed. Similarly, cholinergic neurons in the spinal cord selectively die in MND, causing loss of muscle tone and paralysis. No treatments are effective in treating the underlying cell loss in this debilitating condition.

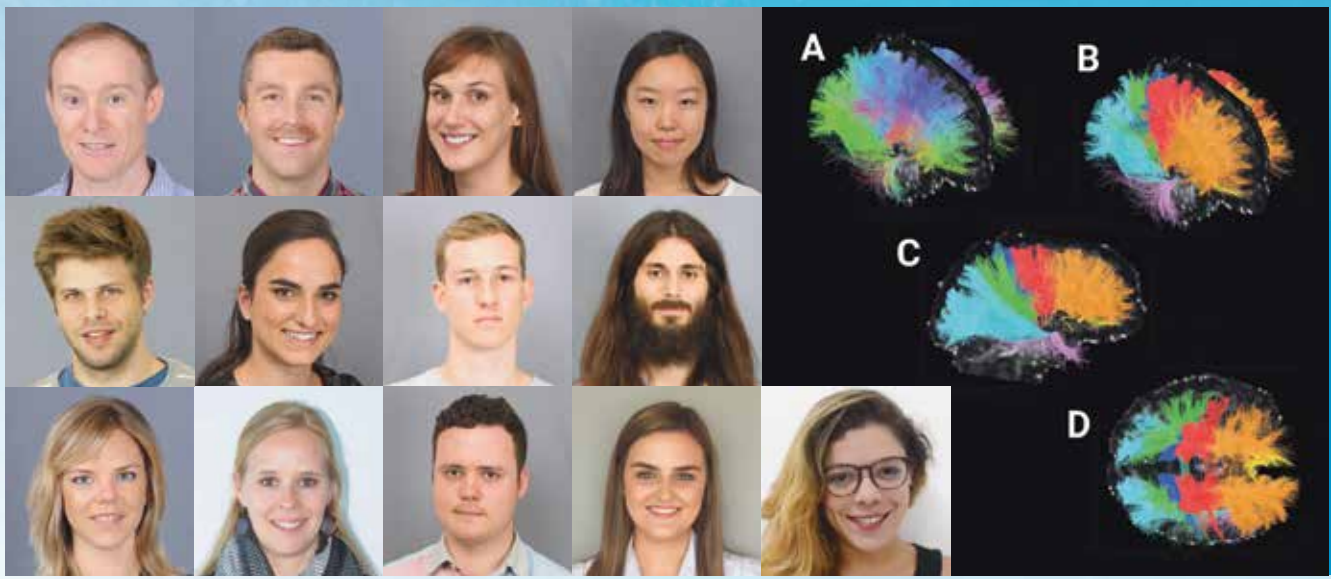
The Coulson group has developed a candidate therapy (called c29) to try to stop the $p75^{NTR}$ death signalling pathway and promote cholinergic neuron survival. They have had success in a mouse model of MND, showing that a three-month c29 infusion could keep dying motor neurons alive for longer, and that treatment delayed disease onset. They further demonstrated that when mice were given the early-version drug, a cell survival signalling pathway was activated, and the cell death signalling pathway used by the p75 protein to kill dying motor neurons was blocked. In addition, collaborators from the University of Adelaide found that a by-product of p75 was found in high levels in people with MND, and could be measured in urine and blood. The c29 treated mice also showed less of this by-product, indicating that motor neuron degeneration was not being activated to the same extent.

A golden hippocampus—a brain structure not only vital for memory, but one that also remotely controls the function of other brain regions.

Sensory-driven and attention-related responses in somatotopic cortex measured at the level of fingertips using ultra-high field (7 Tesla) MRI.



Laboratory head **Professor Ross Cunnington**



Research groups

2015 laboratory members L–R/T–B: Ross Cunnington, Jeff Bednark, Megan Campbell, Yuan Cao, Georg Kerbler, Kelsey Palghat, Jake Palmer, Alex Puckett, Natalie Rens, Eva Reuter, Chase Sherwell, Grace Scott, Nathalia Souza. *Not pictured:* Mildred Taupin. **Image:** Connections between basal ganglia and cortex assessed by tractography. Streamlines are coloured (A) by directionality and (B-D) to illustrate functional circuitry.

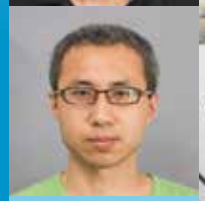
Brain processes for perception and action

The Cunnington laboratory studies how the brain processes sensory information, how attention and predictions influence our perception of this sensory information, how we make decisions based on this information and our previous states to prepare for our own actions, and how we carry out these actions. The group not only strives to make contributions to basic science research, but to also translate these findings into real-world settings such as the clinic and the classroom.

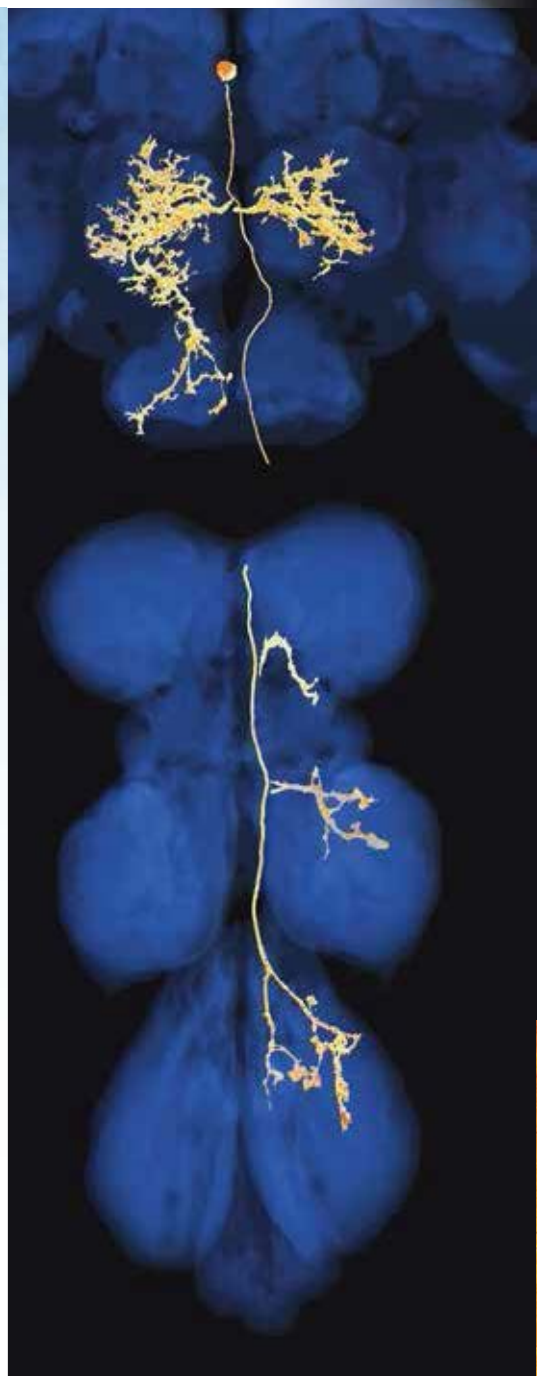
To investigate these brain processes, the Cunnington group employs a wide variety of techniques including electroencephalography (EEG) and magnetic resonance imaging (MRI). Recently, the group has been making use of a new ultra-high field (7 Tesla) MRI scanner at UQ to perform high-resolution imaging. Specifically, the group is using this scanner to examine the cortical processes underlying touch sensation and to examine the function of the fine circuitry of the basal ganglia, which are crucial for higher-order planning and control of voluntary movements. Complementing the use of ultra-high field MRI to study the functional activity within the basal ganglia, the group is also using diffusion MRI to map structural connections among the basal ganglia and cortex.

Other research in the group examines "mirroring" processes that are important for our ability to perceive and understand others. In association with the Australian Research Council's Science of Learning Research Centre, the group is measuring biological markers of brain states between children in school classrooms and applying computational modeling to examine how shared engagement between children, down to the level of their mirrored neurological or brain states, may contribute to learning in group co-operative activities. In addition, the research group is examining neural mirroring and brain processes important for empathy, how these processes are disrupted in people suffering from depression, and potential therapies to target these processes.

Laboratory head **Professor Barry Dickson**



2015 laboratory members T–B: Barry Dickson, Kai Feng. **Image:** The Thorlabs microscope for fast volumetric activity imaging, modified for cell-type-specific activity perturbation experiments.



The central nervous system of *Drosophila* (blue), stained to reveal a single descending neuron that reverses walking direction (yellow).

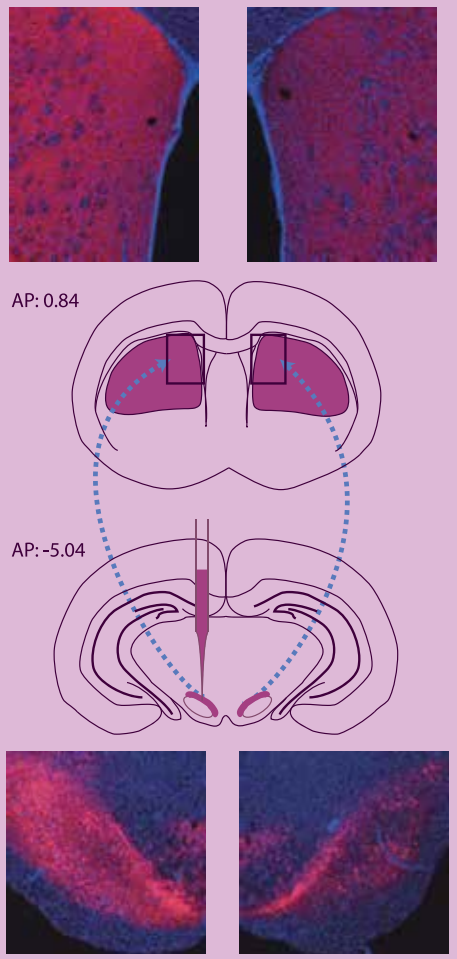
Locomotor circuits in *Drosophila*

The Dickson laboratory investigates the neural circuits that control walking in the fruit fly, *Drosophila melanogaster*. The goal is to understand how local circuits in the nerve cord produce rhythmic motor patterns, how these patterns are co-ordinated across each leg joint and all six legs, and how descending signals from the brain modulate these operations to alter the fly's direction, speed and gait.

The lab started operation at QBI in August 2015. The immediate task was to set up the equipment needed to measure and manipulate neuronal activity in the live nerve cord. Genetically encoded activity reporters and modulators, together with fast volumetric imaging, make it possible to simultaneously monitor the activity of large populations of neurons while acutely manipulating the output of one specific cell type. With this approach, it should be possible to systematically explore the operating principles of the locomotor circuits in the fly's central nervous system.

This system was almost fully functional by year's end, so that the group can now focus on three complementary goals: (1) further expanding the collection of genetic tools that can be used to target activity modulators and reporters to specific cell types, (2) investigating how activity patterns in the nerve cord respond to a descending signal that triggers backward walking, and (3) searching for a complementary descending pathway that initiates forward walking.

Top: Dopamine synthesis is increased in the substantia nigra and its projection target, the caudate nucleus, via the use of a virally delivered genetic construct. Bottom: A snapshot of developing dopaminergic neurons in embryonic rat midbrain.



Laboratory head **Professor Darryl Eyles**

Research groups

2015 laboratory members L–R/T–B: Darryl Eyles, Suzy Alexander, Asad Ali, Xiaoying Cui, Lachlan Ferguson, James Kesby, Pauline Ko, David Kvaskoff, Emilia Lefevre, Leon Luan, Greg Medely, Aung Aung Moe, Kathie Overeem, Renata Pertile, Alice Petty, Tim Reeks, Henry Simila, Stephenie Vuillermot.

Schizophrenia prodrome, autism, development, dopamine, and vitamin D

With a particular focus on dopamine systems, the Eyles laboratory focusses on how risk factors for schizophrenia and autism, such as developmental vitamin D (DVD) deficiency and maternal immune activation, change the way the brain develops and functions.

In 2015 the group made four major discoveries:

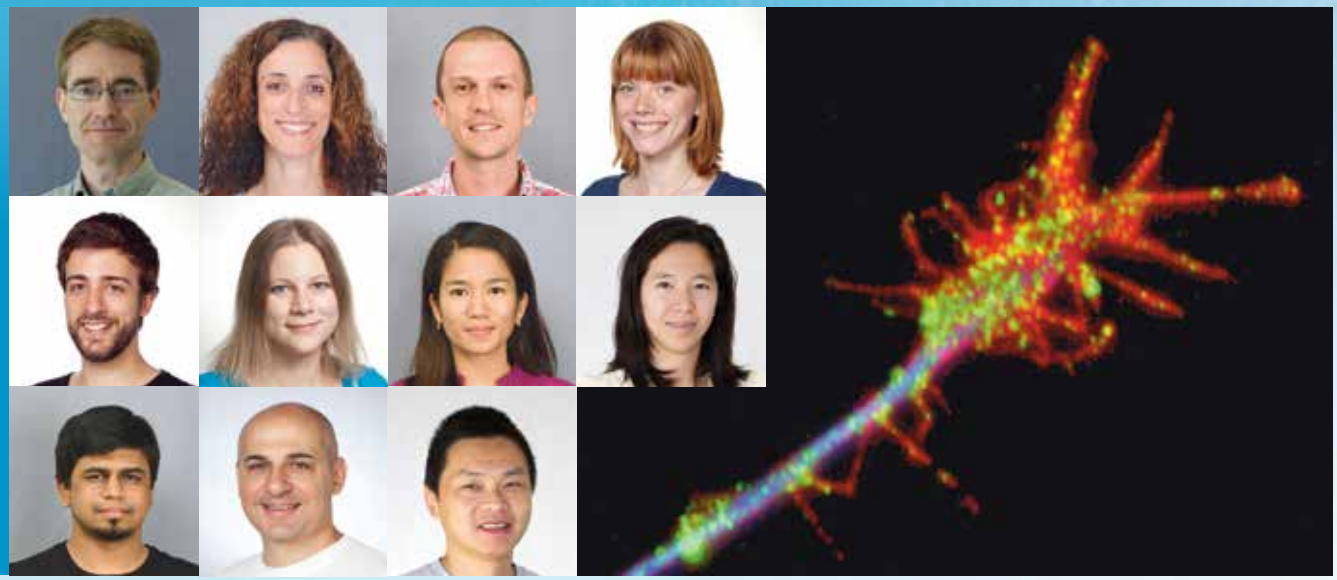
1. In 2010 they established that low maternal levels of vitamin D was a risk factor for schizophrenia. The group has now initiated studies into the relationship between DVD deficiency and autism, with five international collaborations funded by two NIH grants and one NHMRC grant. Initial results indicate DVD deficiency is also a risk factor for impaired social behaviour in children, and autism in particular.

2. Schizophrenia is closely associated with abnormalities in dopamine transmission. The lab's work in DVD-deficient animals confirms early abnormalities in dopamine development and turnover. In 2015, using human cell systems, the group described for the first time how vitamin D exerts direct control over dopamine production via the vitamin D receptor (*Neuroscience*, 2015).

3. The group's collaboration in Zurich has now shown vitamin D is capable of blocking all symptom phenotypes in a maternal immune activation model of schizophrenia. This work (currently under review) has tremendous translational potential.

4. Sub-cortical dopamine systems are pre-symptomatically hyperactive in schizophrenia. Using a novel genetic construct used to treat Parkinson's disease (Lund University), the group developed a model of this important aspect of the schizophrenia prodrome. In collaboration with the clinical group who first showed that dopamine abnormalities were pre-symptomatic in patients at Imperial College London, the Eyles lab were able to completely replicate this phenomenon in an animal model. The group hopes that, using this model, they will be able to trial all current agents directed against preventing the clinical transition to schizophrenia.

Laboratory head **Professor Geoffrey Goodhill**



2015 laboratory members L–R/T–B: Geoffrey Goodhill, Lilach Avitan, Brendan Bicknell, Kelsey Chalmers, Nicholas Hughes, Elizabeth Kita, Margaret Maallo, Huyen Nguyen, Pranesh Padmanabhan, Zac Pujic, Biao Sun. **Image:** The tip of a rat axon stained for different cellular components.

Computational, systems and developmental neuroscience

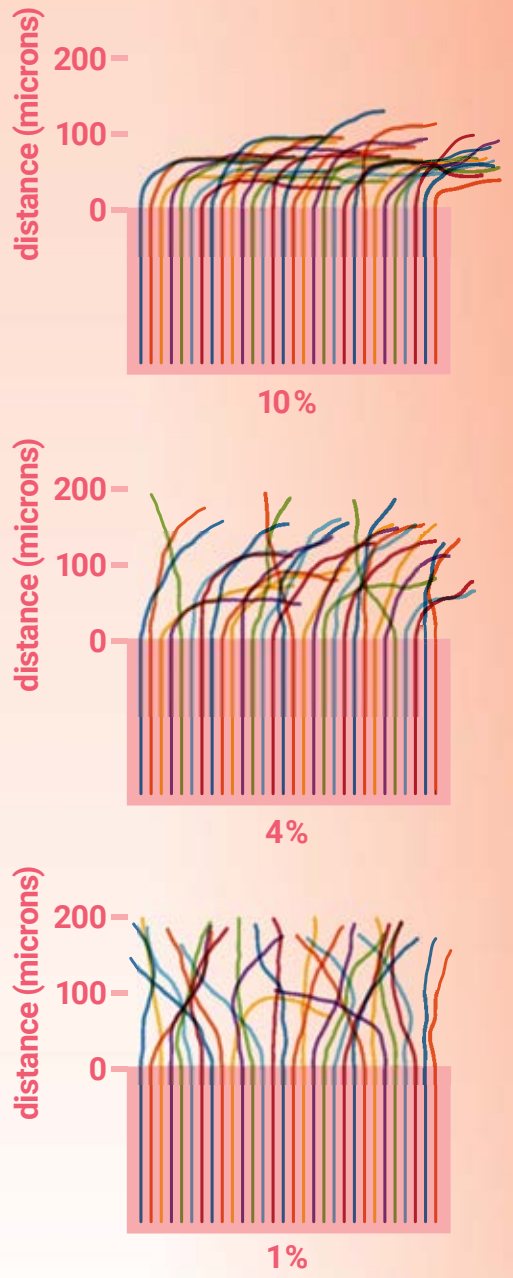
Professor Goodhill's laboratory is interested in how brains process information, particularly during development. This includes how growing nerve fibres (axons) use molecular cues to make guidance decisions, how map-like representations of visual inputs form in the optic tectum and visual cortex, and how these maps code sensory information. The laboratory uses a combination of experimental, mathematical and computational techniques.

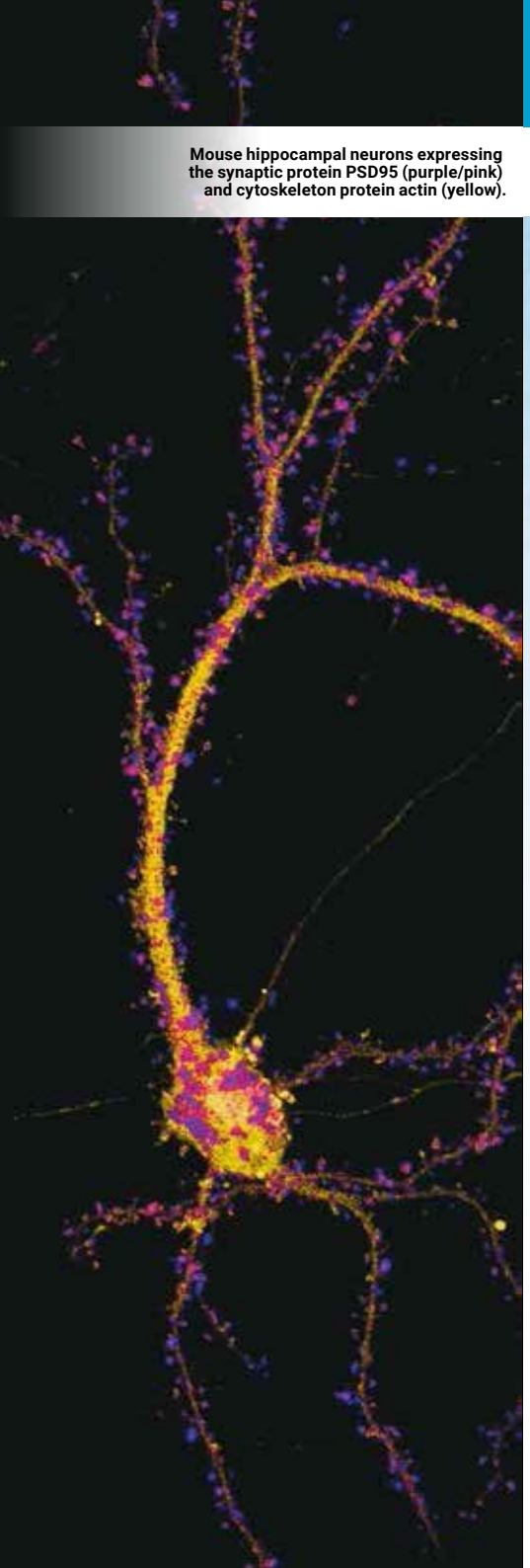
One area of focus is how nerve fibres are guided by molecular gradients to find appropriate targets in the developing nervous system. The laboratory recently found that the trajectories nerve fibres take in gradients can be described by a mathematical model. This model explains why turning of nerve fibres in response to gradients is often surprisingly weak. In 2015 the laboratory was awarded a National Health and Medical Research Council Project grant to continue this work.

Once nerve fibres have reached their targets, connections are refined by neural activity. The laboratory recently discovered a novel way in which sensory experience modifies the structure of these connections in the visual system, revealing a new form of brain plasticity.

The group is also using fluorescent labelling techniques to visualise the simultaneous activity of many neurons in the developing zebrafish brain, both spontaneously active and in response to simple visual stimuli. By using mathematical techniques from statistics and information theory, it is then possible to predict how the zebrafish could optimally decode these patterns of activity in order to determine what visual stimulus was actually present, and determine how these patterns change over development. A better understanding of neural decoding is important for optimising the design of brain-computer interfaces.

Mathematical modelling of different concentration gradients of ligand on axon guidance.





Mouse hippocampal neurons expressing the synaptic protein PSD95 (purple/pink) and cytoskeleton protein actin (yellow).

Laboratory head **Professor Jürgen Götz**

2015 laboratory members L–R/T–B: Jürgen Götz, Siân Baker, J Bertran-Gonzales, Liviu Bodea, Nadia Cummins, Linda Cumner, Xia Di, Harrison Evans, Jasmin Galper, Robert Hatch, Gerhard Leinenga, Chuanzhou (Joe) Li, Miriam Matamales, Rebecca Nisbet, Maryam Odabaee, Tishila Palliyaguru, Matthew Pelekanos, Juan-Carlos Polanco, Zala Skrbis. *Not pictured:* Ann van der Jeugd.

Alzheimer's disease: basic mechanisms and therapeutic interventions

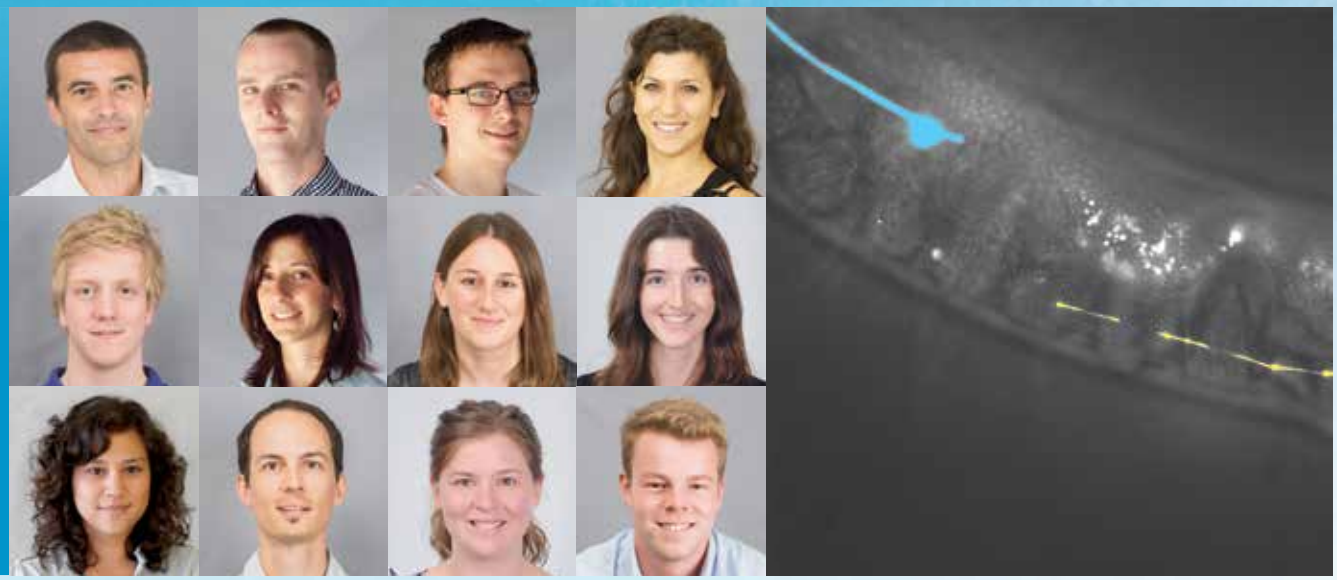
With an increasing life expectancy, the number of Australians suffering from Alzheimer's disease and related dementias, including frontotemporal dementia, is projected to dramatically increase from 320,000 currently to approximately one million by 2050. The Götz laboratory, which forms part of the Clem Jones Centre for Ageing Dementia Research (CJCADR), aims to understand disease initiation and progression at a molecular and cellular level using cellular and animal models, and to develop novel therapies.

2015 has seen significant ongoing funding from both the State and Federal Government, the Australian Research Council and the National Health and Medical Research Council (including a Program Grant on frontotemporal dementia and motor neuron disease), as well as through philanthropy (including the Clem Jones Foundation, the John T Reid Foundation, and Yulgilbar Foundation).

A scientific highlight was the publication of a novel ultrasound-based method of reducing an Alzheimer's amyloid plaque pathology and restoring memory functions in mice. This discovery resulted in significant media attention and public interest. Importantly, the novel approach has not only been extended to rodent models having a tau tangle pathology, but resulted in a pilot study in sheep, which will address the problem of ultrasound attenuation that is associated with the thicker skulls of humans in comparison to mice. The ultimate goal is clinical translation of the discovery.

Additional projects aim to understand ageing-related dysfunction of striatal cholinergic interneurons, the role exosomes and larger microvesicles have in the propagation of tau pathology, how tau impairs the electrophysiological properties of neurons, how tau and the kinase Fyn are transported in neurons, and how amyloid, tau, and Fyn interact in a pathocascade. Regarding therapeutics, a major focus of the laboratory is in developing tau vaccines and blocking excitotoxicity pharmacologically.

Laboratory head **Associate Professor Massimo A. Hilliard**



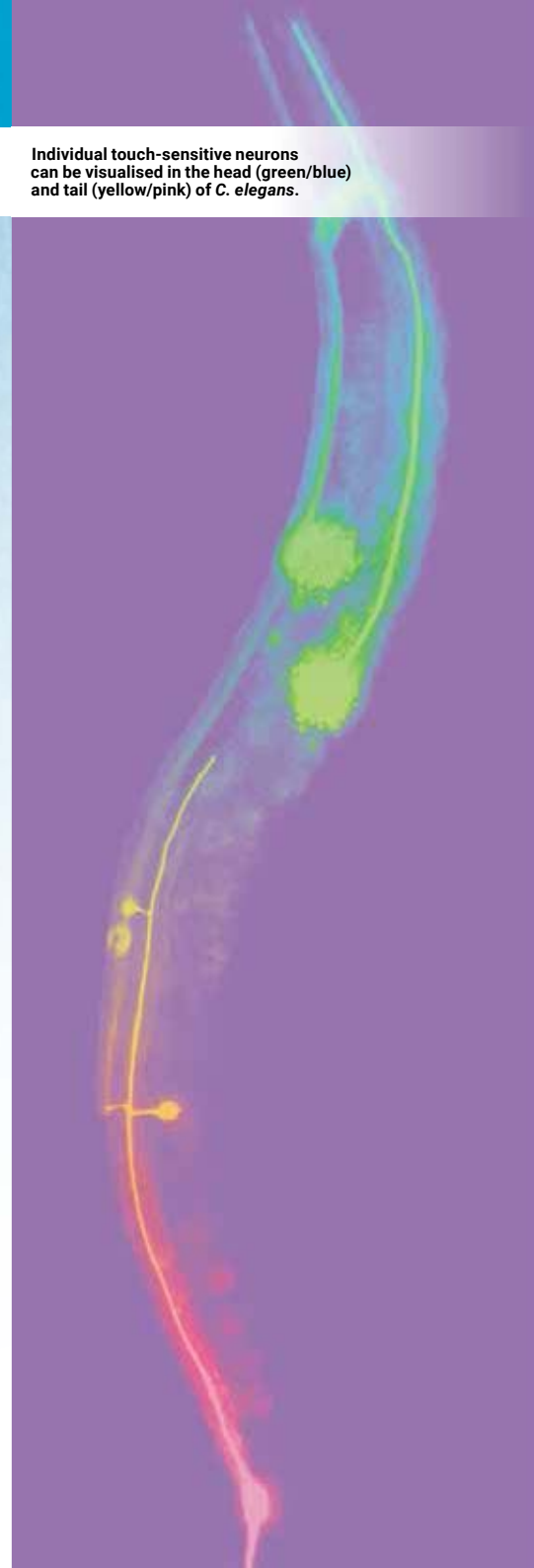
2015 laboratory members L–R/T–B: Massimo A. Hilliard, Justin Chaplin, Sean Coakley, Alessandra Donato, Sam Geraghty, Rosina Giordano-Santini, Eva Kaulich, Casey Linton, Ellen Meelkop, Brent Neumann, Fiona Ritchie, Michael Van Der Mark. *Not pictured:* Apurva Kumar. **Image:** A degenerating neuron (yellow) can be studied alongside a healthy neuron (blue) in a live *C. elegans*.

Molecular mechanisms of axonal development, regeneration, and degeneration

The Hilliard laboratory is focused on understanding the molecular mechanisms that regulate neuronal development, maintenance and repair, using *C. elegans* as a model system. The group's current research goals are: (1) how the axon, which is the longest of the neuronal processes, is subdivided into structurally and functionally different compartments, (2) how the axon maintains its structure and function over the lifetime of the organism, and (3) how the axon can be repaired when severing damage occurs.

Using a combination of molecular biology, genetics, laser manipulations, and imaging approaches, the Hilliard group has made a number of key discoveries in these research areas. They include: the axonal protective function of a conserved alpha tubulin acetyltransferase (*Cell Reports*, 2014); the role of conserved apoptotic molecules in axonal degeneration; and the identification of the molecular mechanisms that regulate axonal fusion, an axonal repair event in which the two separated fragments of an injured axon rejoin and reconstitute the original tract (*Nature*, 2015). This latest discovery on how axonal fusion is achieved has important implications for medical practice: a similar strategy may be used to facilitate nerve repair.

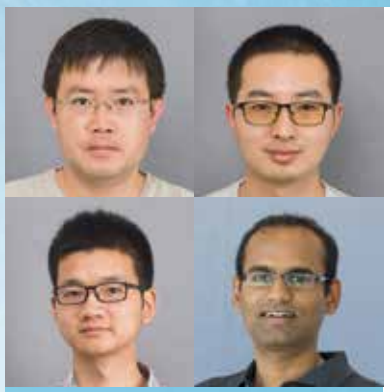
The Hilliard group has been successful in attracting competitive funding that includes an ARC Discovery Project, an NHMRC Senior Research Fellowship, and a NHMRC-ARC Dementia Fellowship.

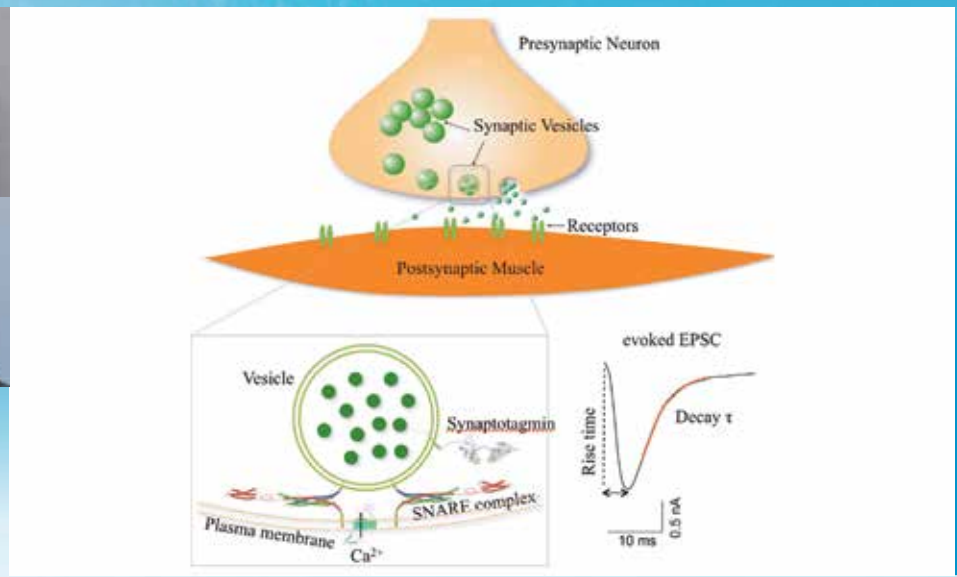


Individual touch-sensitive neurons can be visualised in the head (green/blue) and tail (yellow/pink) of *C. elegans*.

***C.elegans* is an ideal model organism in which to study the genetics of synaptic function.**

Laboratory head **Dr Zhitao Hu**





2015 laboratory members L–R/T–B: Zhitao Hu, Lei Li, Haowen Liu, Ramesh Narayanan. **Image:** Molecular machinery of synaptic vesicle exocytosis.

Understanding the molecular mechanisms of synaptic transmission

Over the last few decades, one of most important objectives in the field of neuroscience has been to understand the molecular and cellular mechanisms that regulate neurotransmitter release, which drives neuronal communication in the nervous system. Many model organisms have been used to address this question, including the mouse, fly, zebrafish, and octopus. Among these organisms, *C. elegans* has emerged as a powerful genetic model to study synaptic function. *C. elegans*, through the study of its functional role in neurotransmission, provides a cost-effective strategy for genetic testing. The Hu group focusses on candidate genes to understand their functional importance in synapses.

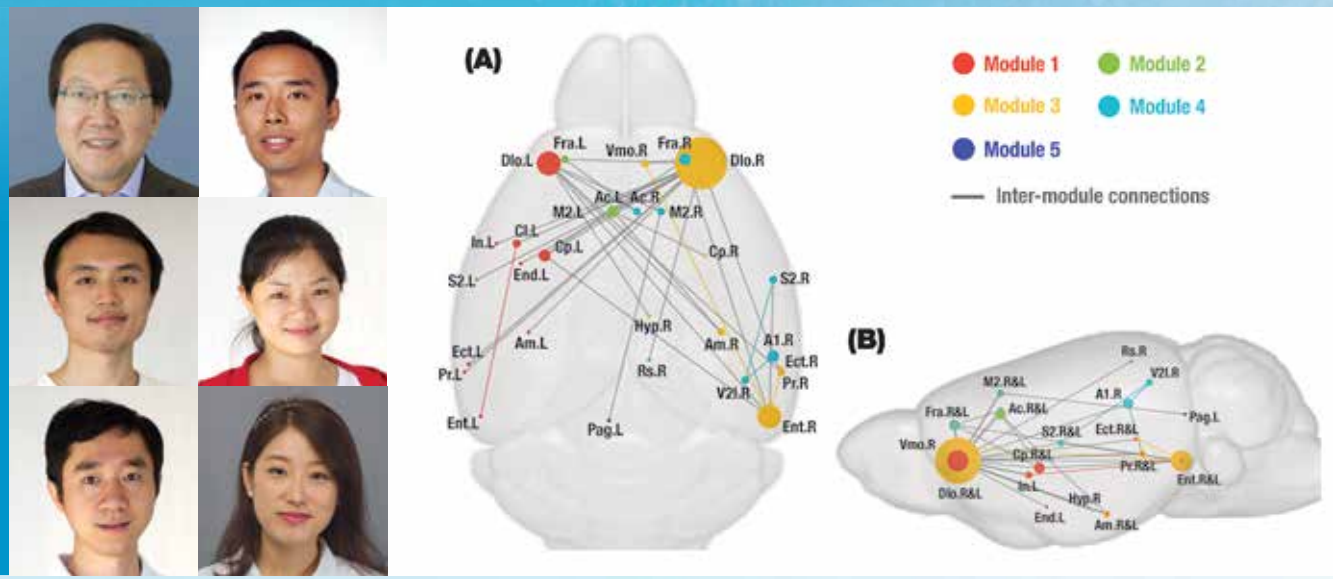
Combining electrophysiological recording, cellular imaging, molecular biology, and biochemistry approaches, the Hu group focusses on:

1. Kinetic regulation of synaptic vesicle release: Understanding the kinetics of how neurotransmitters are released has broad implications. The speed of the neurotransmission limits the efficiency and the communication rate between neurons and strongly influences local circuit dynamics. It has also had profound effects on circuit development and cognition. The Hu laboratory studies synaptic proteins that affect release kinetics to determine the underlying molecular mechanisms.

2. The molecular/cellular mechanisms of different release forms: Neurotransmitters can be released in two forms: evoked fusion after an action potential, and spontaneous fusion. The Hu group focusses on determining the cellular mechanisms underpinning these two release forms. Increasing evidence indicates that different fusion machinery is used for the two forms. Although its physiological function is still uncertain, spontaneous release has been proposed to be important in multiple processes, including long-term facilitation induction and homeostatic synaptic plasticity modulation.

3. Synaptic transmission defects in neurological diseases: Recent advances in genomic and bioinformatics technologies have identified DNA variants associated with neurological disorders such as autism and motor neuron disease. The Hu lab seeks to understand the functional roles of these candidate genes.

Laboratory head **Professor Tianzi Jiang**



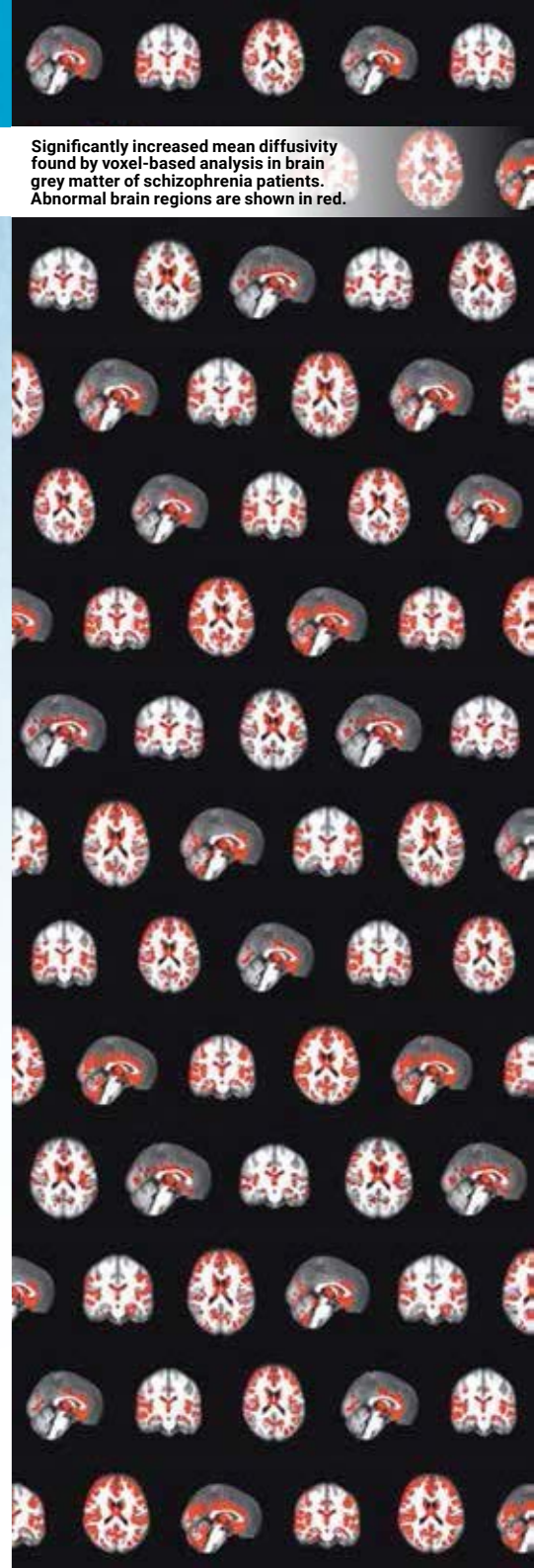
2015 laboratory members L–R/T–B: Tianzi Jiang, Yonghui Li, Cirong Liu, Tong Wu, Xianfeng Yang, Xiaoqing (Alice) Zhou. **Image:** Connection-wise comparison reveals abnormal inter-modular and inter-hemispheric connectivities in socially isolated mice.

Mapping abnormal brain networks in humans and animals with MRI

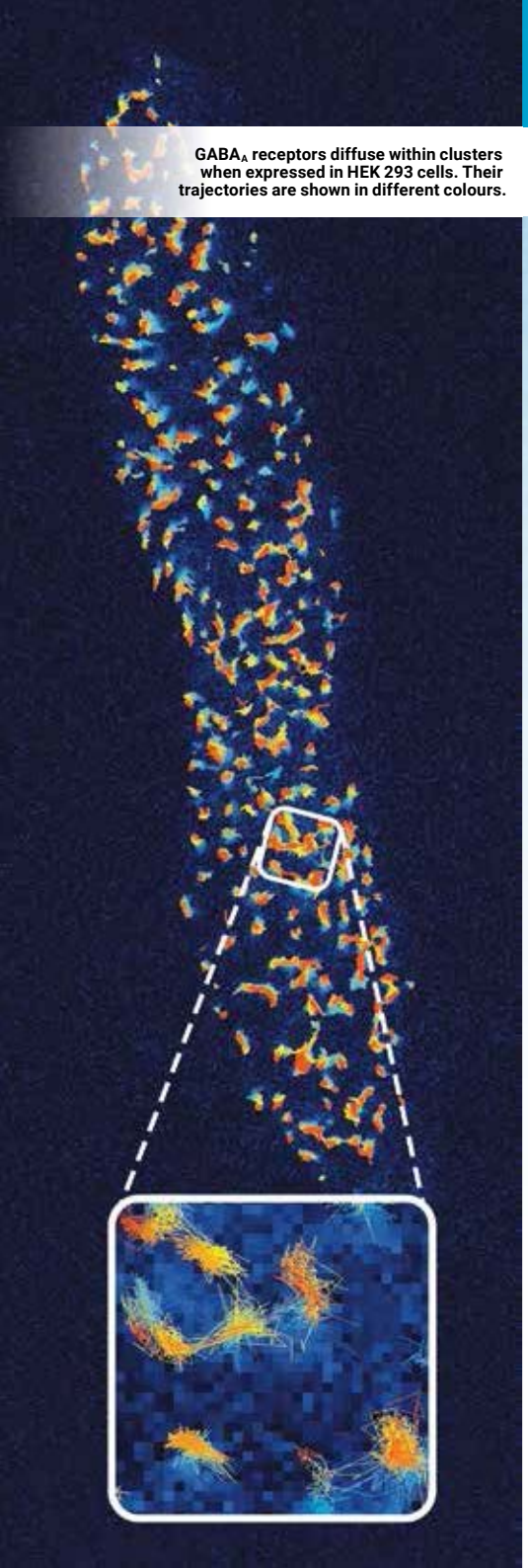
Convergent evidence has shown that brain functions can manifest at different scales within brain networks, and that the malfunctions associated with most psychiatric disorders are the result of faulty brain networks. The Brainnetome (www.brainnetome.org) provides a foundation for integrating the multi-level network features obtained with various functional and anatomical brain imaging technologies. The Jiang laboratory is studying basic theory, methodologies and algorithms underpinning the Brainnetome platform, and their applications in neurological and psychiatric diseases.

In 2015, one study from the Jiang laboratory focussed on the "abnormal neurodevelopment" theory of schizophrenia. Inspired by previous findings from neonatal brains, the group proposed that an increase in diffusion magnetic resonance imaging (dMRI) mean diffusivity (MD) should be observed in the cerebral cortex of schizophrenia patients compared with healthy controls, corresponding to lower tissue complexity and potentially a failure to reach cortical maturation. The group tested this hypothesis using dMRI data from a Chinese Han population comprising patients from four different hospital sites. Significantly increased MD measurements were consistently observed in the cortex of schizophrenia patients across all four sites, despite differences in psychopathology, exposure to antipsychotic medication and scanners used for image acquisition (Li and Xie *et al.*, *Translational Psychiatry*, 2015).

In addition to findings in humans, the laboratory also made significant progress in animal studies, particularly in the study of adolescent socially isolated mice. By combining dMRI and behavioural examinations, the Jiang laboratory revealed that the isolated mice displayed a disorganised brain connectome, which was most evident in the dorsolateral orbitofrontal cortex and was associated with fear memory deficits and hyper-locomotion activities induced by social isolation. Considering the key role of the orbitofrontal cortex in social behaviours, adolescent social isolation may primarily disrupt the orbitofrontal cortex and its neural pathways, thereby contributing to a structurally disorganised connectome.



Significantly increased mean diffusivity found by voxel-based analysis in brain grey matter of schizophrenia patients. Abnormal brain regions are shown in red.



$GABA_A$ receptors diffuse within clusters when expressed in HEK 293 cells. Their trajectories are shown in different colours.

Laboratory head **Professor Joe Lynch**

2015 laboratory members L–R/T–B: Joe Lynch, Xiumin Chen, Christine Dixon, Nela Durisic, Argel Estrada, Justine Haddrill, Robi Islam, Sharifun Islam, Angelo Keramidas, Kooi Yeong Khaw, Atif Mohammed, Suzanne Scott, Ming Shiuan Soh, Sahil Talwar, Yan Zhang. **Image:** Superposition of conventional (green punkta) and super-resolution image (orange dots) of cortical neuron expressing $GABA_A$ receptors. The receptors at the synapse form tight clusters (bright puncta) while the extrasynaptic ones are more mobile.

Structure and function of GABAergic and glycinergic synapses

The Lynch laboratory's major research interest concerns the molecular structure and function of the glycine and $GABA_A$ receptor ($GABA_AR$) chloride channels that mediate inhibitory neurotransmission in the brain. The $GABA_AR$ is an important therapeutic target for sedative and anxiolytic drugs and the glycine receptor (GlyR) has recently emerged as a therapeutic target for pain, spasticity, epilepsy and tinnitus. The Lynch laboratory is discovering new drugs active at these receptors and the molecular mechanisms by which their structures and functions are disrupted in hereditary neurological disorders.

The ability to remotely control neuronal activity holds promise for treating human neurological disorders caused by aberrant activity levels, including motor neuron disease, Parkinson's disease, addiction, anxiety and epilepsy. Previous research in the laboratory led to the development of an improved "neuronal silencing receptor" for inhibiting electrical activity in defined populations of neurons in behaving animals. More recently the laboratory has developed a "neuronal activating receptor" for activating defined neuron populations in the brain. This complements the silencing approach and offers a new tool for defining how the brain works in health and disease.

As synaptic $GABA_ARs$ are formed from a wide variety of subunits, many isoforms are possible in vivo. Each isoform exhibits unique pharmacological and physiological properties, and has a unique role in brain function. The Lynch group recently developed techniques for reliably generating "artificial" inhibitory synapses that incorporate the defined $GABA_AR$ subunits of interest. The group found that synaptic $GABA_ARs$ incorporating γ1 and γ2 subunits exhibit very different functional properties. Using high-resolution imaging to track the movement of these receptors in real time, the group found that they move at different rates on the cell surface. This may contribute to their differing functional properties.

Laboratory head **Professor Justin Marshall**

2015 laboratory members L–R/T–B: Justin Marshall, Fanny de Busserolles, Karen Cheney, Wen-Sung Chung, Fabio Cortesi, Yakir Gagnon, Alejandra Galan, Alan Goldizen, Naomi Green, Kyra Hay, Diana Kleine, Yi-Hsin Lee, Martin Luehrmann, Genevieve Phillips, Gabriella Scata, Qamar Schuyler, Sara Stieb, Rachel Templin, Hanne Thoen.

The iridescent eye and body colouration of a pufferfish. Reef fish colours and how they are perceived are one of the areas of research in the Marshall laboratory.

Visual mechanisms and visual communication on the Great Barrier Reef

With questions such as, *Why are reef fish colourful?* and *Why are octopus colour blind?*, research in the Marshall laboratory is focussed on neuroethology in Australia's vibrant marine environment. Neuroethology is both lab and field-based neuroscience. It aims at understanding how the brains and sensory systems of animals in the real world have been shaped by their environment and needs.

The Marshall group's work is based around cephalopod (e.g., squid), crustacean (e.g., shrimp) and fish neuronal structure and function. Using these model systems, the group uses sensory biology to both compare vertebrate and invertebrate vision and take a systems approach to neuroscience including anatomical, electrophysiological, molecular (transcriptomics) and behavioural methods, along with quantifying light in the natural environment.

The mechanisms behind colour vision and polarisation vision in fish, stomatopod crustaceans and the cephalopods have been a focus in 2015 with important discoveries published in top-tier journals such as *Current Biology, Current Opinion in Neurobiology, Proceedings of the National Academy of Sciences* and *American Naturalist*. A new gene duplication event discovered by Fabio Cortesi and co-workers is helping unravel the complexity of marine fish colour vision. The first example of sexually dimorphic vision in vertebrates was discovered by Fanny de Busseroles, and in a study led by Genevieve Phillips, transcriptomics revealed the colour vision capabilities of wrasse, the ocean's most colourful fish.

2015 saw lab head Justin Marshall's Australian Research Council Laureate Fellowship used to build a hub for neuroethology in Australia. Other milestones for laboratory members included attainment of a PhD by Genevieve Phillips and the commencement of three new PhDs. Highly competitive fellowship or postdoctoral awards were won by Hanne Thoen, Wen-Sung Chung and Fabio Cortesi to continue work on stomatopods, cephalopods and fish respectively. The *Springer Series in Vision Research* book series based from the Marshall lab, along with close collaborator Shaun Collin, now contains five volumes with two more in press for 2016.

Attention filters incoming visual information (shapes), relying on neural oscillations (coloured lines) to coordinate activity across distant brain areas.

Laboratory head **Professor Jason Mattingley**

2015 laboratory members L–R/T–B: Jason Mattingley, Corinne Bareham, Oliver Baumann, Nicholas Bland, Luca Cocchi, Daina Dickins, Hannah Filmer, Marta Garrido, Michelle Hall, Anthony Harris, Luke Hearne, Barbara Jachs, Oscar Jacoby, Roxanne Jemison, Marc Kamke, Delphine Levy-Bencheton, David Lloyd, Natasha Matthews, Jessica McFadyen, Valdas Noreika, Abbey Nydam, David Painter, Martin Sale, Cooper Smout, Matthew Tang, Susan Travis, Ashika Verghese, Lisa Wittenhagen. *Not pictured:* Eloise Crawshaw.

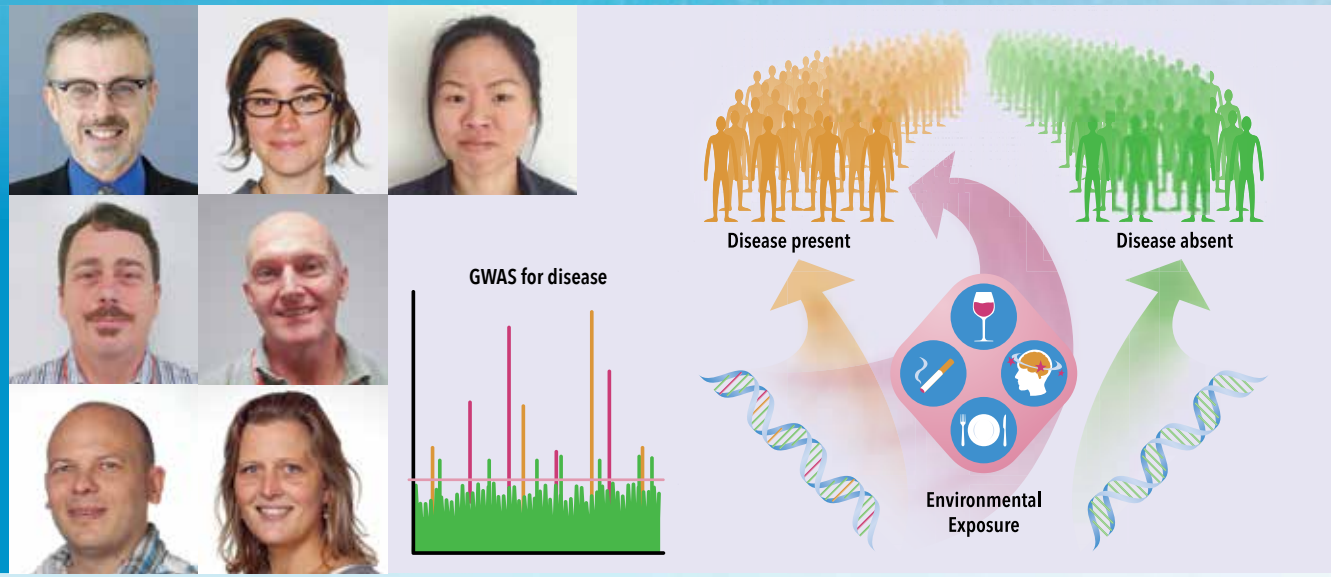
Understanding human attention networks

Researchers in the Mattingley laboratory investigate how the human brain gives rise to perception, cognition and the control of movement, in health and disease. The group is inspired by a desire to understand how people use attention to prioritise information, whether from the sensory world or from internal thought processes. They also investigate learning, with the aim of harnessing new discoveries from the field of neuroscience to enhance learning outcomes throughout life. A particularly important part of the research involves understanding how perceptual and cognitive processes can be impaired in brain disorders such as stroke. The group employs a range of approaches to investigate these questions, including behavioural tests, imaging and brain stimulation methods.

In 2015, researchers in the Mattingley laboratory made several important discoveries. Graduate student Luke Hearne published a paper in *Human Brain Mapping* showing how brain networks are reconfigured dynamically in response to increases in the complexity of a cognitive task. In other work, postdoctoral fellow Luca Cocchi published a paper in the *Journal of Neurophysiology* showing how reversible inhibition or excitation of a small region of the cerebral cortex induces widespread changes in activity patterns throughout the adult human brain. Finally, in a paper published in *NeuroImage*, postdoctoral fellow David Painter discovered that a small region within the human temporal lobe is critical for visual attention.

2015 also saw a number of important milestones in the Mattingley laboratory. Daina Dickins, Oscar Jacoby and Claire Naughtin were all awarded PhDs. In addition, postdoctoral fellows Oliver Baumann and Luca Cocchi were awarded Project Grants by the National Health and Medical Research Council. Lab head Jason Mattingley was invited to join the Australian Research Council's "College of Experts", and was also appointed Associate Director of the ARC Centre of Excellence for Integrative Brain Function.

Laboratory head **Professor John McGrath**



2015 laboratory members L–R/T–B: John McGrath, Helen Gooch, Carmen Lim, Greg Medley, Tim Reeks, Henry Simila, Anna Vinkhuyzen. **Image:** Genetic factors can influence the risk of a disease directly, or indirectly via increasing the chance of exposure to environmental factors. The McGrath group is using data from local and international studies to unravel the influence of genetic and environmental factors on the risk of mental disorders.

The prevention and treatment of schizophrenia

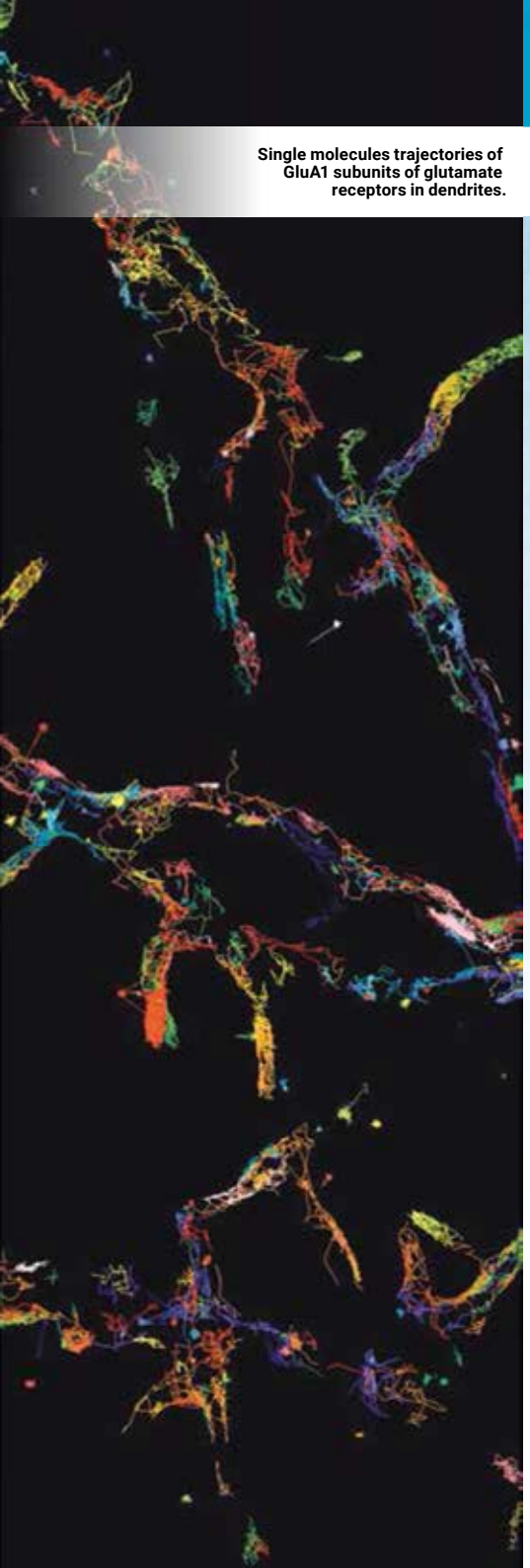
In 2015 the McGrath group commenced a major new research program to find better treatments for psychotic disorders. Funded by the John Cade Fellowship, and in collaboration with Associate Professor James Scott (UQ Centre for Clinical Research), the McGrath group and staff from the Queensland Centre for Mental Health Research have linked up with clinicians around south-east Queensland. The Cadence clinical trials program has commenced randomized control trials of new candidate treatments for those with psychosis (www.cadencetrials.com).

The McGrath laboratory aims to explore risk factors linked to schizophrenia and other mental disorders. They focus on non-genetic factors that are potentially modifiable. In recent years the team has been examining the impact of low vitamin D (the "sunshine hormone") during early brain development and on adult brain function. In collaboration with Professors Darryl Eyles and Associate Professor Thomas Burne, they have developed animal models to examine the impact of low vitamin D during gestation on brain development. The group has established a new research program with Professor Pankaj Sah and Dr Helen Gooch to explore links between vitamin D and voltage-gated calcium channels.

Previously in 2013, Professor McGrath was awarded a prestigious National Health and Medical Research Council John Cade Fellowship in Mental Health Research. These funds have allowed the group to explore a wider range of modifiable risk factors (e.g. infectious agents, stress, cannabis, vitamin D), a more diverse range of brain-related outcomes (e.g. prenatal and neonatal brain growth, childhood neurocognition, autism, schizophrenia, other mental disorders), and a wider range of epidemiological samples (in collaboration with national and international groups). New projects include an international study related to psychotic experiences in the general community (Harvard University and 19 other universities). The group has also been extending studies related to vitamin D in international datasets by exploring gene–environment interactions.

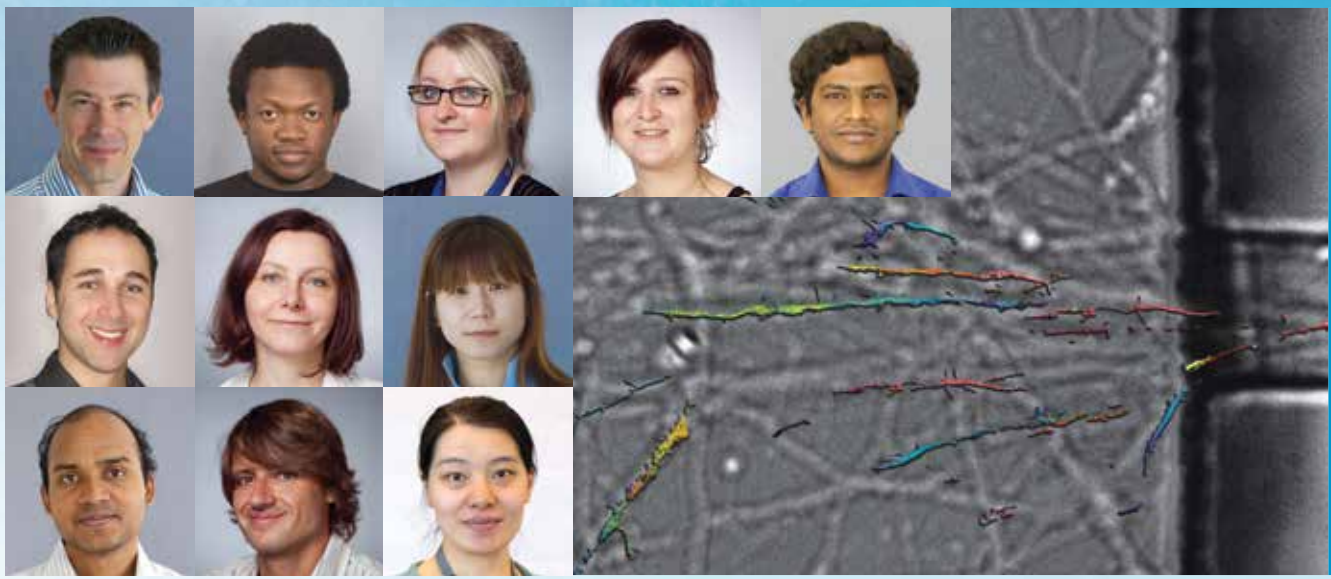
The first Cadence clinical trial involves adding sodium benzoate (BZ) to standard antipsychotic medicines. A commonly used food preservative, benzoate can also influence neurotransmitter pathways thought to be implicated in schizophrenia.

Cadence BZ



Single molecules trajectories of GluA1 subunits of glutamate receptors in dendrites.

Laboratory head **Professor Frederic Meunier**



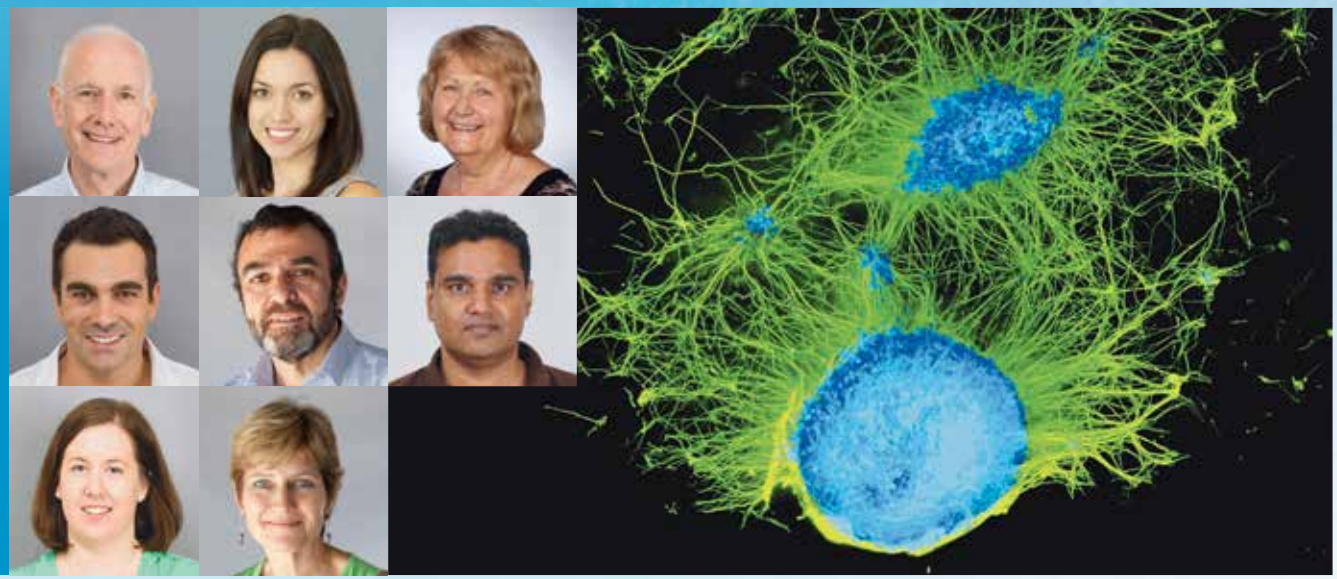
2015 laboratory members L–R/T–B: Frederic Meunier, Adekunle Bademosi, Rachel Gormal, Callista Harper, Ravikiran Kasula, David Kvaskov, Sally Martin, Ye Jin Chai, Vinod Narayana, Andreas Papadopulos, Tong (Iris) Wang. **Image:** Phase-contrast image showing nerve bundles extending from a microfluidic channels. Trajectories of retrograde BoNT/A-Hc single molecules are shown as overlying coloured traces.

Mechanisms underlying neuronal vesicular trafficking

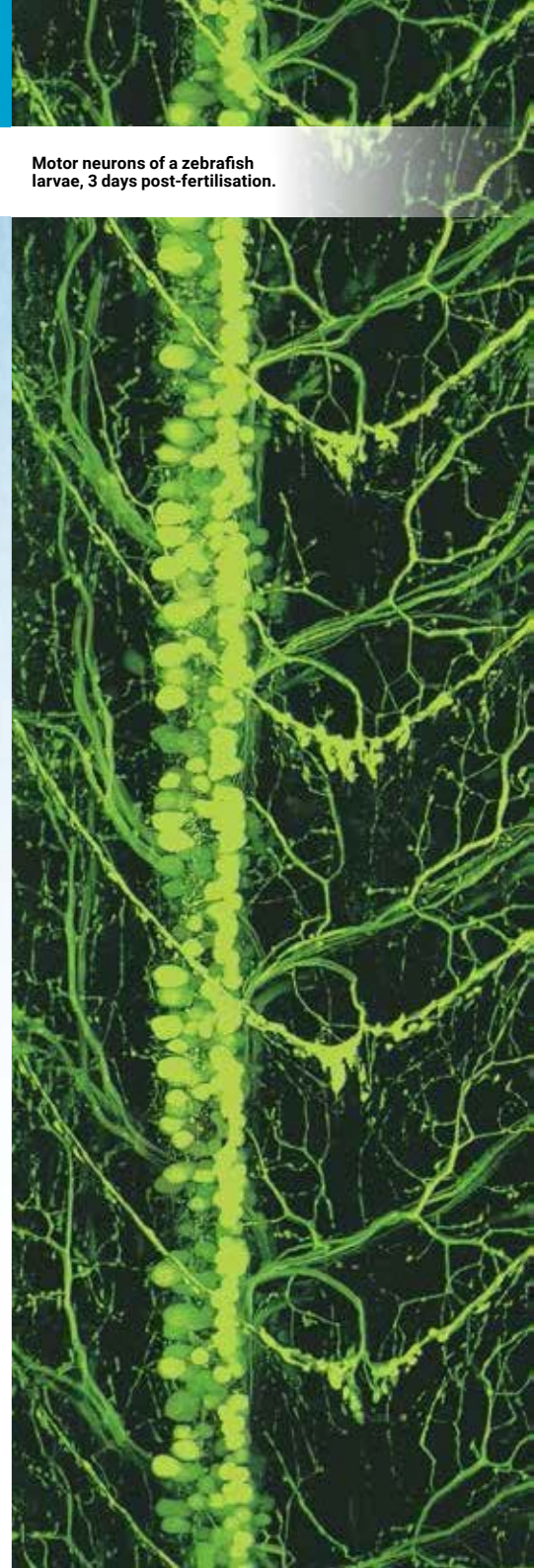
In 2015, the Meunier laboratory explored the mechanisms underpinning vesicular trafficking in neurons and neurosecretory cells. They focussed on what cause secretory vesicles (containing neurotransmitter) to be trafficked, dock at the plasma membrane, and undergo exocytosis, thereby releasing their content and mediating neurotransmission. In a paper published in *Nature Communications* and highlighted by the F1000, the group provided the first demonstration that relaxation of the cortical actin network allows bound secretory vesicles to access the plasma membrane in a concerted manner. This casting net effect effectively synchronises the vesicles' approach to the plasma membrane. The Meunier group also discovered that the cortical acto-myosin II network regulates the reuptake of membrane by bulk endocytosis (*Journal of Neuroscience*, 2015). We pursued our collaboration with Professors Damien Keating and Phil Robinson and co-published a study in *Molecular Psychiatry* looking at manipulating the fusion pore from the neurosecretory cell with small molecular inhibitors of the protein dynamin.

As part of the Clem Jones Centre for Ageing Dementia Research, the Meunier laboratory has capitalised on the recent acquisition of several super-resolution microscopes to uncover how neurotrophic factors are packaged in nanodomains of presynaptic terminals and then channelled back to the cell body. In a study published in the *Journal of Neuroscience* and highlighted in the F1000, they demonstrated that synaptic activity controls the flux of autophagosomes undergoing retrograde axonal transport. Finally, the group established the first multiplex mass spectrometry assay to accurately measure free fatty acids and started to unravel a new pathway in the mechanism of neuroexocytosis involving the production of saturated free fatty acids in brain cells (Narayana *et al.*, *Chemistry and Biology*, 2015). These works have implications for the understanding of a number of diseases that are caused by defects in vesicular trafficking, including neurodegenerative conditions such as Alzheimer's disease, as well as epilepsy.

Laboratory head **Professor Bryan Mowry**



2015 laboratory members L–R/T–B: Bryan Mowry, Ilvana Dzafic, Cheryl Filippich, Jean Giacomotto, Bill Mantzioris, Sathish Periyasamy, Rachel Suetani, Heather Smith.
Image: Mixed forebrain neurons differentiated from induced pluripotent stem cells (iPSCs), stained for the neuronal marker beta-III tubulin (green).



Motor neurons of a zebrafish larvae, 3 days post-fertilisation.

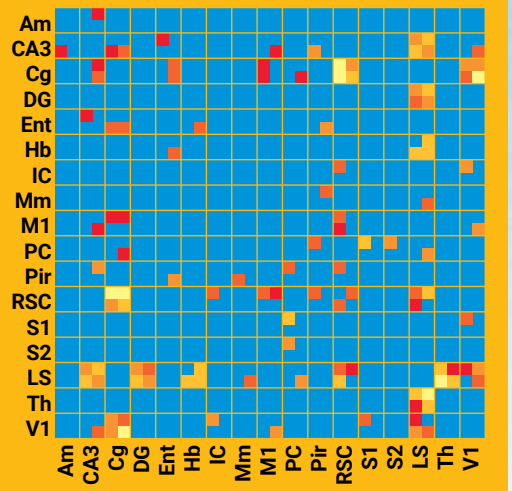
From susceptibility loci to pathophysiology

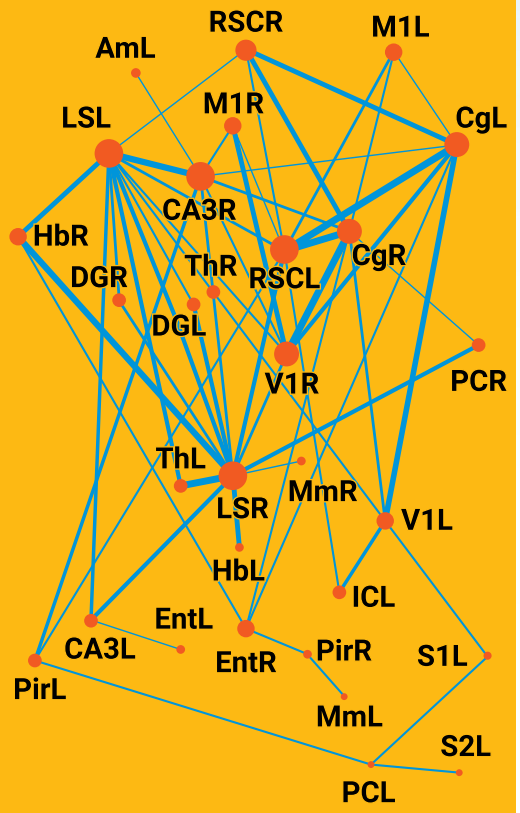
The Mowry laboratory aims to identify and functionally characterise susceptibility genes for schizophrenia and related disorders. The group aims to achieve this by utilising genome-wide association studies (GWAS), DNA and RNA sequencing, and gene expression studies. The group hopes to further characterise the function of discovered genetic variants by studying these in zebrafish and in neuronal cells derived from induced pluripotent stem cells (iPSC) sourced from patients.

Current studies include: (1) continuing recruitment of southern Indian schizophrenia families and unrelated cases and controls in collaboration with Dr Thara, Director, Schizophrenia Research Foundation, Chennai; (2) neuroimaging and neuropsychological phenotyping of selected schizophrenia patients and a matched sample of healthy individuals; (3) GWAS analyses in homogeneous Indian and Sarawak populations, comparing the results with the latest results for European-ancestry schizophrenia from the Psychiatric Genomics Consortium; (4) targeted resequencing analyses of a previously identified chromosomal region in an Indian sample; (5) establishing iPSC from selected schizophrenia patients and controls in order to test disease hypotheses; (6) studying the function of the group's top Indian GWAS locus in zebrafish and cellular models.

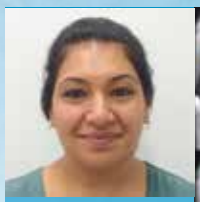
A successful NHMRC grant (2016–2018), "Investigating the aetiopathogenic role of autoantibodies against the M1 muscarinic acetylcholine receptor in patients with first episode of schizophrenia" with colleagues, Associate Professor Judith Greer and Associate Professor James Scott will enable the Mowry laboratory to study the relationship between higher levels of antibodies and particular disease symptoms. The group will further investigate how these antibodies may worsen specific symptoms.

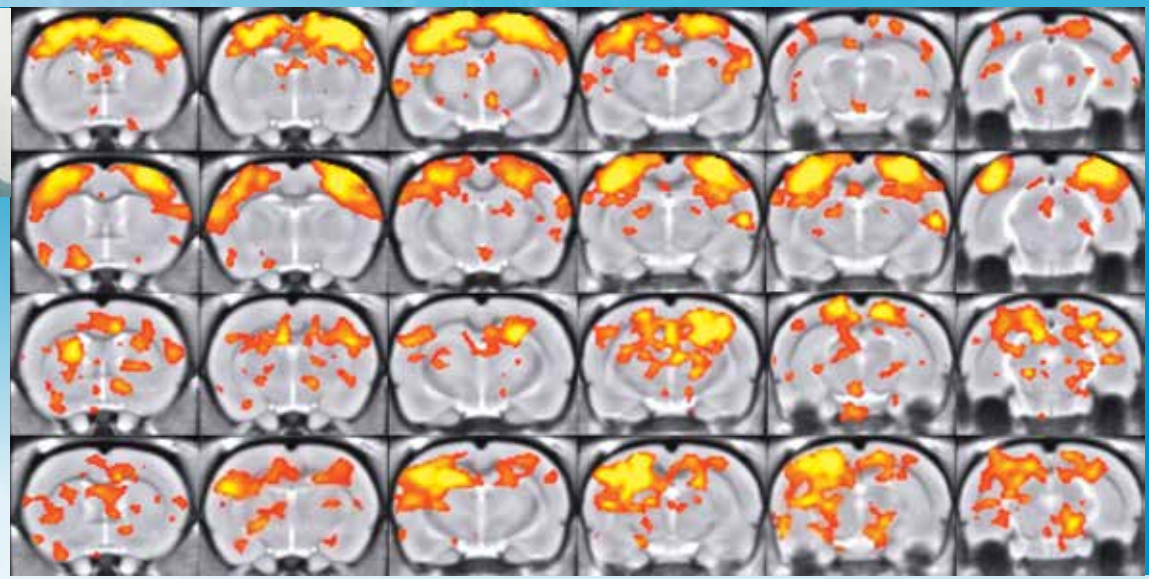
Correlation matrix (top) and network connectivity plot (bottom) of regions in the rat brain following spatial memory learning tasks.





Laboratory head **Dr Fatima Nasrallah**





Research groups

2015 laboratory members: Fatima Nasrallah. **Image:** Resting-state functional correlation maps in the rat brain show extensive connectivity enhancement following spatial learning on a Morris water maze. Correlations are based on reference seeds from the left primary somatosensory area (S1), left primary visual cortex (V1), left hippocampal CA3, and right hippocampal CA3.

Traumatic brain injury and dementia

Traumatic brain injury (TBI) occurs when an external force traumatically injures the brain, often as a result of traffic accidents, sports injuries, or violence. The effects of TBI can range from a concussion to severe brain damage and even death. Signatured with a complex pathophysiology, TBI encompasses changes to molecular, cellular, functional, and gross anatomical structure with a cascade of deleterious physiological changes following the initial impact. Recent studies have shown TBI to be associated with an increased risk of early-onset dementia, as key protein aggregates, which incidentally also play a role in Alzheimer's disease and frontotemporal dementia, have been reported in patients who have sustained a TBI.

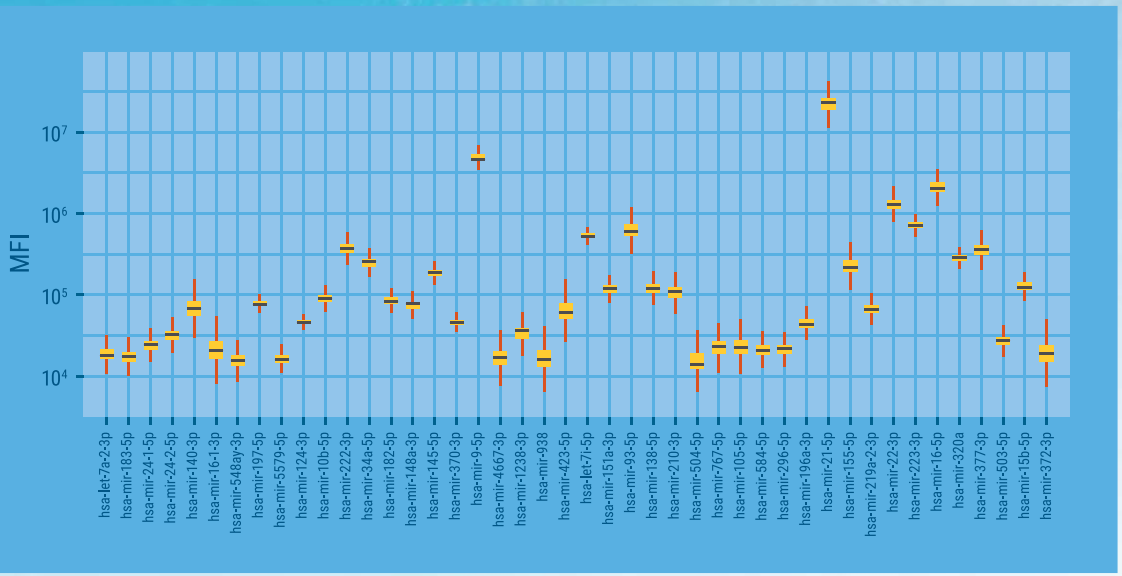
Previously, Dr Nasrallah has demonstrated extensive experience in the application of multimodality imaging methods such as magnetic resonance imaging (MRI), especially resting state functional MRI (rsfMRI), positron emission tomography and electrophysiology, to understand brain function in rodents and humans.

She was able to demonstrate, for the first time, the potential to detect changing resting state networks following a cognitive task in the sedated rodent brain using rsfMRI. She was also the first to detect such resting state functional connectivity networks in the mouse brain.

Having moved to QBI in late 2015, her laboratory aims to harness multimodality methods to identify and comprehend the fundamental mechanisms triggered following TBI. This will allow mapping of structural, functional, metabolic and molecular changes in the brain in an attempt to cross-link imaging metrics with behavioural measures and protein biomarkers, giving insight into the pathophysiology of TBI and its link to dementia. The scope of the research will include: (1) development and validation of animal models of TBI, (2) development of specific imaging tools and diagnostic molecular biomarkers of TBI and dementia, and (3) translation of novel imaging tools and biomarkers to clinical investigations.

Laboratory head **Mr Geoffrey Osborne**

Research groups



2015 laboratory members T–B: Geoffrey Osborne, Virginia Nink. **Image:** Flow cytometric screening of relative microRNA expression levels from tumour sample are studied to identify those that may hold prognostic or diagnostic significance.

Flow cytometry as a key tool in brain cancer research

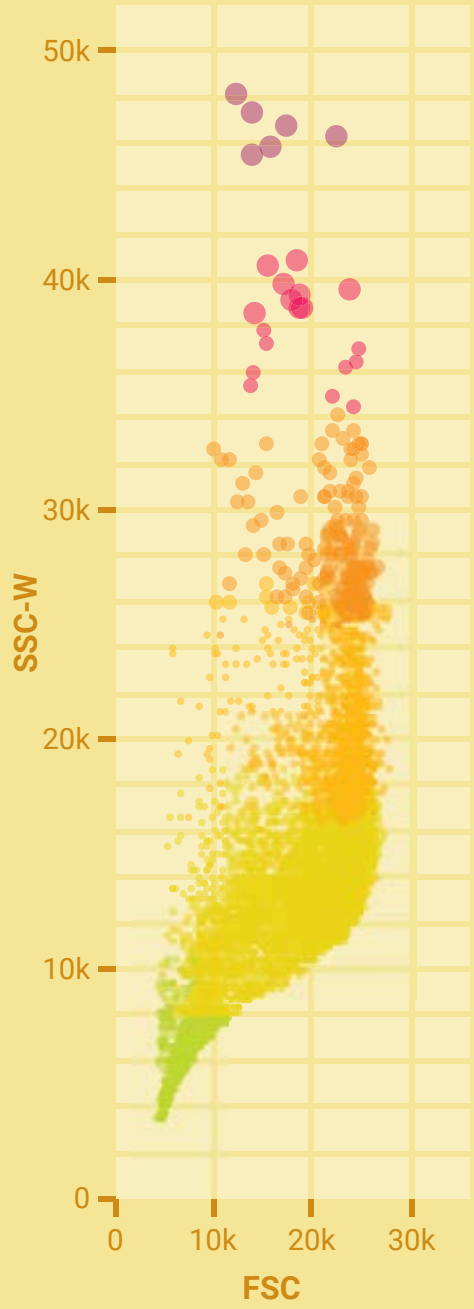
As Director of Flow Cytometry for both QBI and the Australian Institute for Bioengineering and Nanotechnology, Mr Geoffrey Osborne leads a team that provides crucial cell sorting and analysis services to researchers both within QBI and across the University. The laboratory specialises in analysing and separating cells from dissociated solid tissue, blood and cultured cell lines. In addition, the laboratory is involved in brain cancer research and instrumentation development.

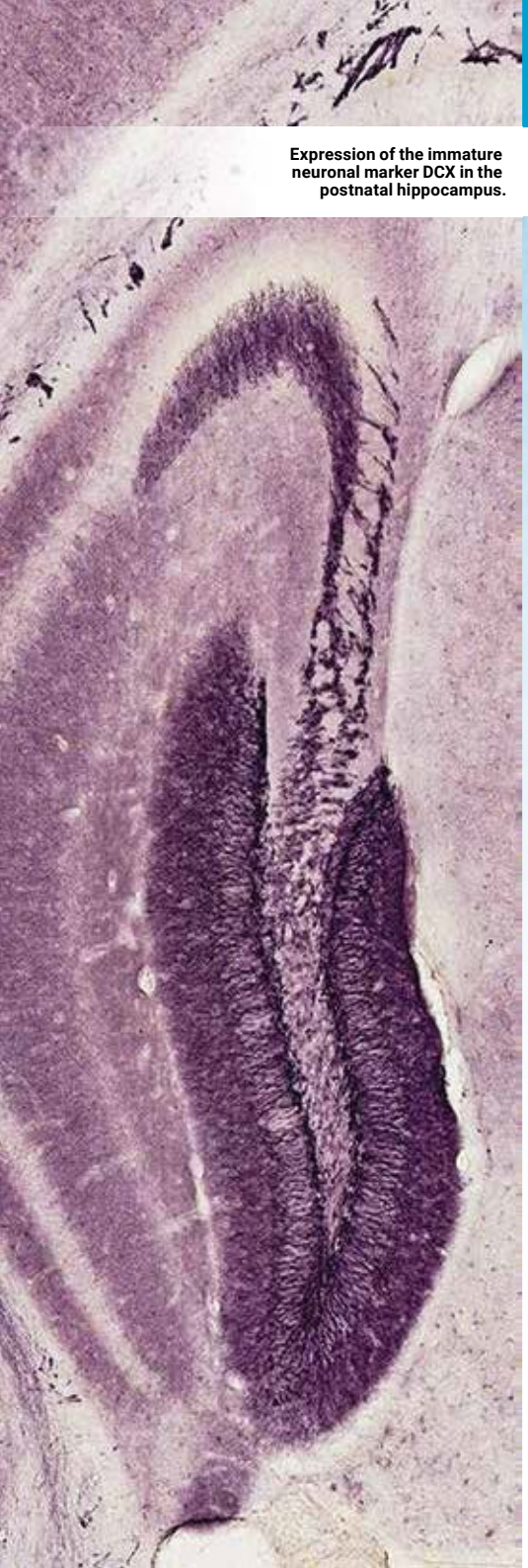
One area in which flow cytometry can be applied is selecting and isolating single cells of interest from mixed populations. Increasingly, this is being utilised in single-cell transcriptomics, single-cell PCR and other molecular biology applications.

In 2008 group leader Osborne identified a flaw in the available single-cell sorting algorithms that flow cytometers use as the basis of single-cell sorting, and invented a novel solution to address this problem. Following a long development and testing process this method was published in *Cytometry Part A* in 2015. The paper showed that sampling the complete diversity present within a population for characteristics of interest is now possible, and that cells that would otherwise be missed are selected and enriched. This has implications for stem cell studies and areas in which cells of interest are infrequent. A software implementation of this method was also commercialised by UniQuest in 2015.

The quantification of particular microRNAs using a novel flow cytometry assay is another area that the laboratory actively pursued in 2015. The laboratory optimised a method that allows the rapid assessment of microRNA levels from brain tumour patient samples that may have prognostic value in a clinical relevant time frame. Work continues in this area with the hope developing a microRNA "fingerprint" predictive of patient survival.

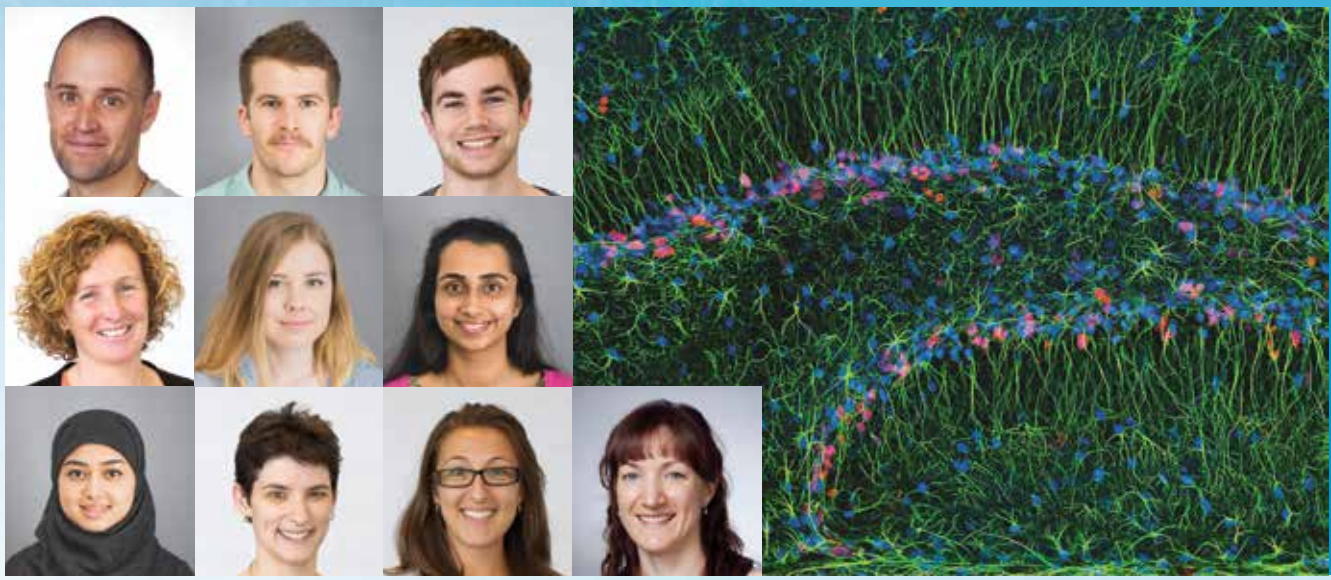
Studies of perturbation of the cell cycle are using colour coding and differential dot sizing to allow the visualisation of up to seven measured parameters in bivariate displays.





Expression of the immature neuronal marker DCX in the postnatal hippocampus.

Laboratory head **Dr Michael Piper**



2015 laboratory members L–R/T–B: Michael Piper, James Fraser, Lachlan Harris, Tracey Harvey, Elise Horne, Swati Iyer, Sabrina Oishi, Chantelle Reid, Diana Vidovic, Oressia Zalucki. **Image:** Expression of neural stem cell markers GFAP (green), SOX2 (blue) and Ki67 (red) in the postnatal hippocampus.

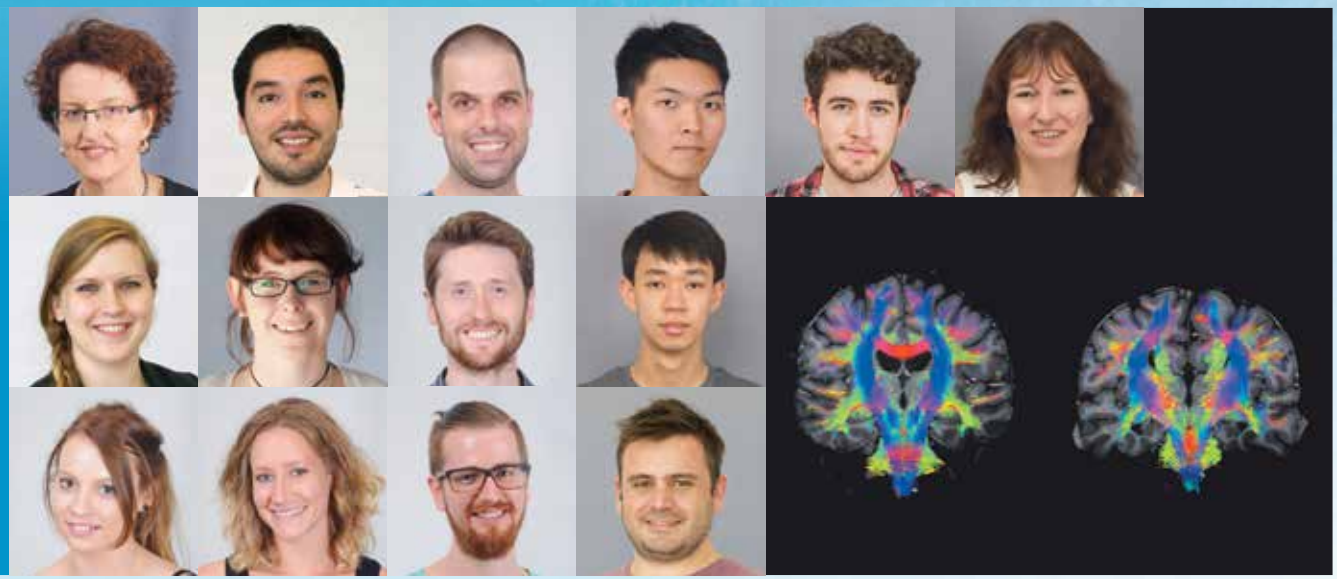
Molecular control of neural stem cell differentiation

The mature neuronal and glial cells that populate our brains are all ultimately derived from neural stem cells. These stem cells are predominantly found within the embryonic brain, and they must proliferate, and then differentiate, in a spatially and temporally appropriate fashion to produce the right number, as well as type, of cells within the brain. Neural stem cells are also found in the adult brain, where they provide ongoing neurogenesis throughout life. The production of new neurons in the adult brain has been linked to crucial processes such as learning and memory. Understanding how neural stem cell differentiation is controlled is critical if we are to understand the normal trajectory of brain development. Moreover, this research will provide insights into developmental disorders and diseases such as brain cancer.

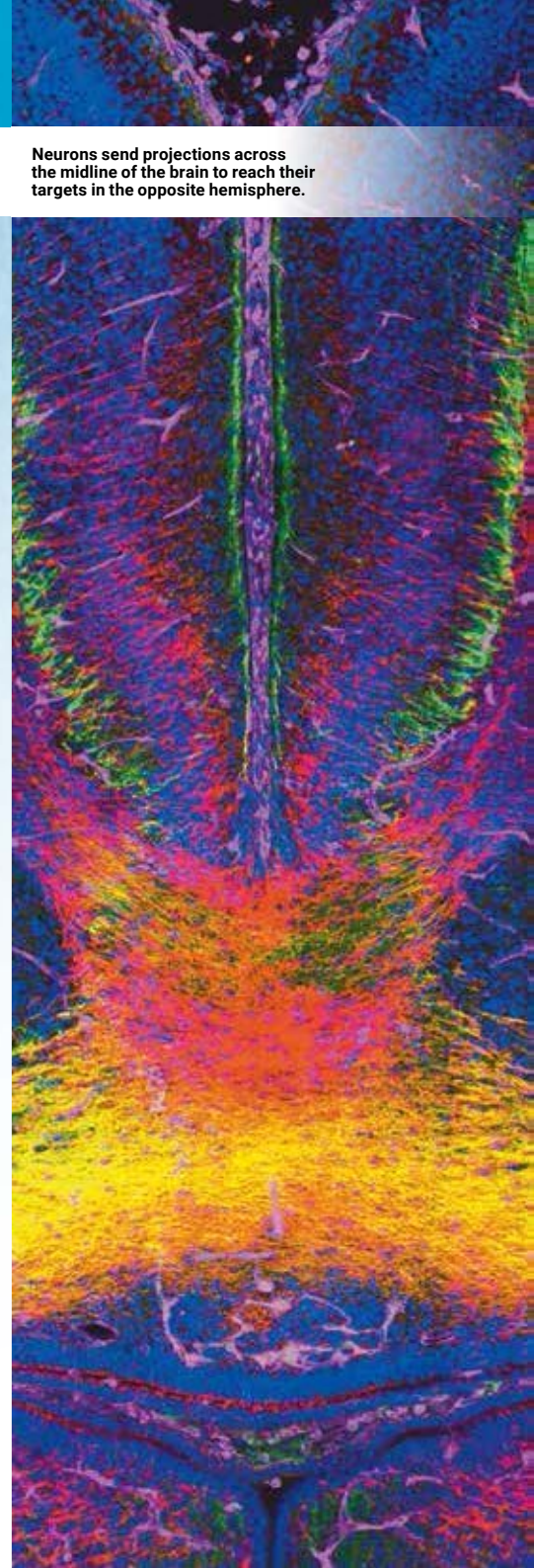
The Piper laboratory studies the genes that control neural stem cell differentiation in the developing and the adult brain. To do this, the group uses mouse model systems and in vitro cell culture paradigms to investigate the key processes behind the biology of neural progenitor cells, and to reveal the genetic hierarchy that controls neural progenitor cell differentiation. Moreover, the Piper laboratory is also applying these findings to investigate disorders such as glioma and medulloblastoma, which are characterised by unrestrained stem cell proliferation.

The group's recent work has revealed some of the key processes underlying how neurogenesis in the postnatal brain is co-ordinated (Heng *et al*., *Cerebral Cortex*, 2015), and how abnormalities in this process can culminate in a serious neurodevelopmental disorder known as hydrocephalus (Vidovic *et al*., *Brain Research*, 2015). Current work in the Piper laboratory is aimed at further elucidating the genes mediating neural stem cell differentiation in the developing brain, and how misregulation of such genes can culminate in brain cancer.

Laboratory head **Professor Linda J. Richards**



2015 laboratory members L–R/T–B: Linda Richards, Gonzalo Almarza, Jens Bunt, Kok-Siong Chen, Tim Edwards, Sinead Eyre, Laura Fenlon, Ilan Gobius, Peter Kozulin, Jonathan Lim, Laura Morcom, Annalisa Paolino, Thomas Pollak, Rodrigo Suárez. **Image:** Human brain tracts identified using magnetic resonance imaging and computer-generated tractography.



Neurons send projections across the midline of the brain to reach their targets in the opposite hemisphere.

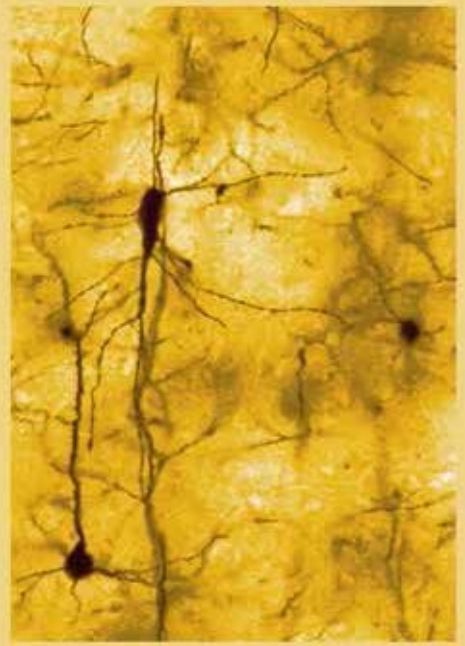
Wiring up the developing brain

The Richards laboratory began a new era of research in 2015 by establishing protocols for examining brain wiring in human subjects. To launch this, the laboratory hosted an international conference called Cortical Connections, where a new international consortium of scientists and clinicians working on developmental brain disorders was established. The consortium will bring data together from different laboratories in Australia and internationally to help identify genes causing human brain disorders. The consortium will also collect brain MRI data and neuropsychological data to try to understand the relationship between specific patterns of brain wiring and brain function. In this same area, the laboratory was awarded a National Institutes of Health grant with Professor Elliott Sherr (University of California, San Francisco) and Professor Bill Dobyns (Seattle University, Washington) who are internationally leading paediatric neurologists and geneticists, and a National Health and Medical Research Council grant with Professor Sherr and QBI researcher Associate Professor Tom Burne. These grants will specifically identify genes that cause human developmental brain disorders, and investigate their function.

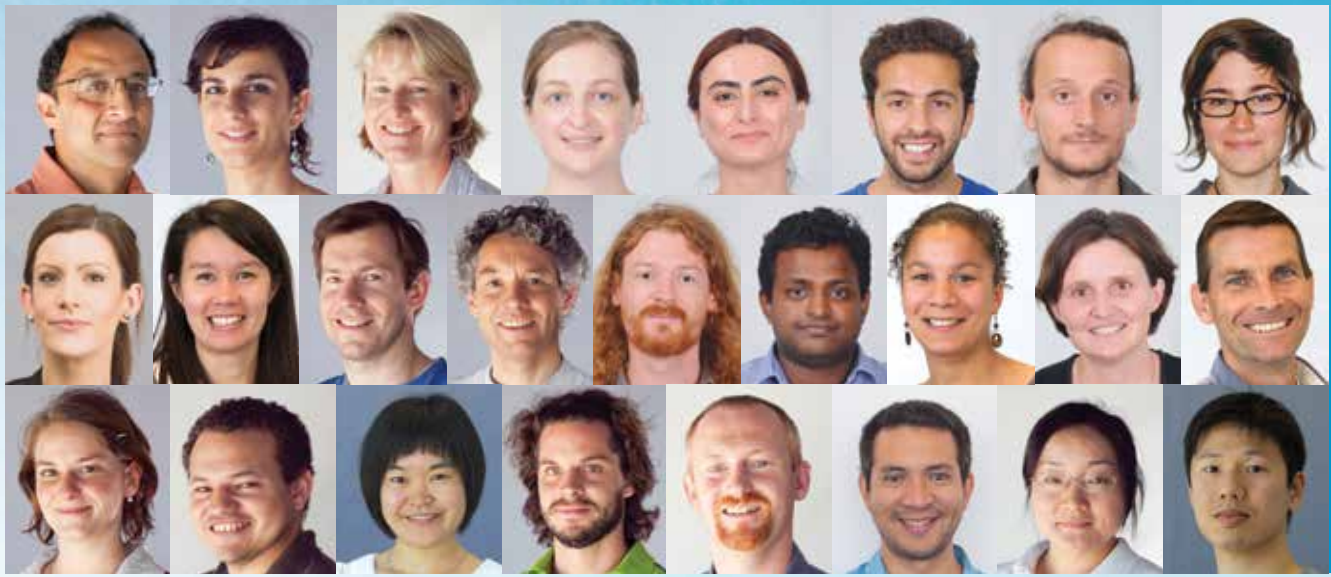
Laboratory members won a number of awards in 2015. MD/PhD student Timothy Edwards won Best Student Poster at the 2015 Brisbane Cell and Developmental Biology Meeting: "Utilising mouse models to study altered brain wiring in corpus callosum agenesis". PhD student Laura Fenlon received first prize for the best oral presentation at the ISN-APSN-ANS 2015 Satellite Meeting in Cairns, and a trainee professional development award ($3000) from the American Society for Neuroscience (SfN). PhD student Jonathan Lim was awarded an International Postgraduate Research Scholarship and UQ Centennial Scholarship, and PhD student Laura Morcom was awarded a full Australian Postgraduate Research Award.

Senior postdoctoral fellow Dr Rodrigo Suárez was the recipient of an Australian Research Council Discovery Early Career Researcher Award ($592,700), as well as the Rebecca Cooper Medical Research Foundation Award ($22,000). Dr Suárez and Professor Richards also received a new four-year Australian Research Council grant to study brain development in marsupials. Senior postdoctoral fellow Dr Jens Bunt was awarded a grant for his work on brain cancer from the Tour de Cure Foundation.

Golgi staining of neurons reveals very fine details of their morphology and allows connections between individual cells to be resolved.



Laboratory head **Professor Pankaj Sah**



2015 laboratory members L–R/T–B: Pankaj Sah, Eleanora Autuori, Suzanne Campbell, Christine Dixon, Arezoo Fallah, Amu Faiz, Andrea Giorni , Helen Gooch, Rebecca Harvey, Sarah Hunt, Roger Marek, John Morris, Chris Nolan, Madhusoothanan Bhagavathi Perumal, Margreet Ridder, Petra Sedlak, Peter Stratton, Cornelia Strobel, Robert Sullivan, Yajie Sun, Fabrice Turpin, François Windels, Alan Woodruff, Li Xu, Shanzhi Yan. *Not pictured:* Samuel Hunt, Alex Vourvoukelis.

Neural circuitry and mechanisms underpinning learning and memory

The Sah laboratory uses electrophysiology and molecular techniques, in conjunction with behavioural studies, to understand the neural circuitry that underpins learning and memory formation. Using animal models, the laboratory focusses on the part of the brain called the amygdala, and a Pavlovian learning paradigm called fear conditioning. The group uses viruses to deliver optogenetic constructs to neurons in defined regions, and then records the electrical activity in acute brain slices to study the neural circuits and the properties of these connections. The group is mapping the circuits that provide auditory and noxious information to the amygdala, and is in interested in the circuits that connect the amygdala with the prefrontal cortex and hippocampus. This information is then used to understand the role of these circuits in behaviour.

In collaboration with Professor Joe Lynch at QBI, the group is exploring the molecular identity of receptors at inhibitory connections in the amygdala. In the last year this work has concentrated on the properties of synaptic γ-aminobutyric (GABA) receptors that contain γ1 subunits. These receptors are enriched in specific circuits in the amygdala and could be targets for the development of new anxiolytic drugs.

The animal studies are complemented by electrophysiological recordings in humans. For these studies, Professor Sah collaborates with Professor Peter Silburn and Dr Terry Coyne who together are part of the Asia–Pacific Centre for Neuromodulation (APCN), to study neural activity in the human brain in patients undergoing neurosurgery for deep brain stimulation. These recordings are revealing the activity in the human brain in a range of movement disorders, such as Parkinson's disease, essential tremor and Tourette syndrome. In 2016, the group will be involved in a clinical trial for the treatment of obsessive compulsive disorder.

Laboratory head **Professor Mandyam Srinivasan**

2015 laboratory members L–R/T–B: Mandyam Srinivasan, Julia Groening, Debajyoti Karmaker, Michael Knight, Kiaran Lawson, Ingo Schiffner, Dean Soccol, Reuben Strydom, Hong Vo, Mahadeesh Yadav, Michael Wilson. *Not pictured:* Peter Anderson, Aymeric Denuelle. **Image:** A Queensland fruit fly (*Bactrocera tryoni*) is tethered to a metal rod so that it can navigate through a virtual environment.

Visually guided flight in animals and unmanned aircraft

Birds and bees display remarkable navigational capacities, despite their diminutive brains. The Srinivasan Biorobotics laboratory is using these animals as models to understand how vision guides flight and enables navigation, and to design biologically inspired systems for the guidance of aircraft.

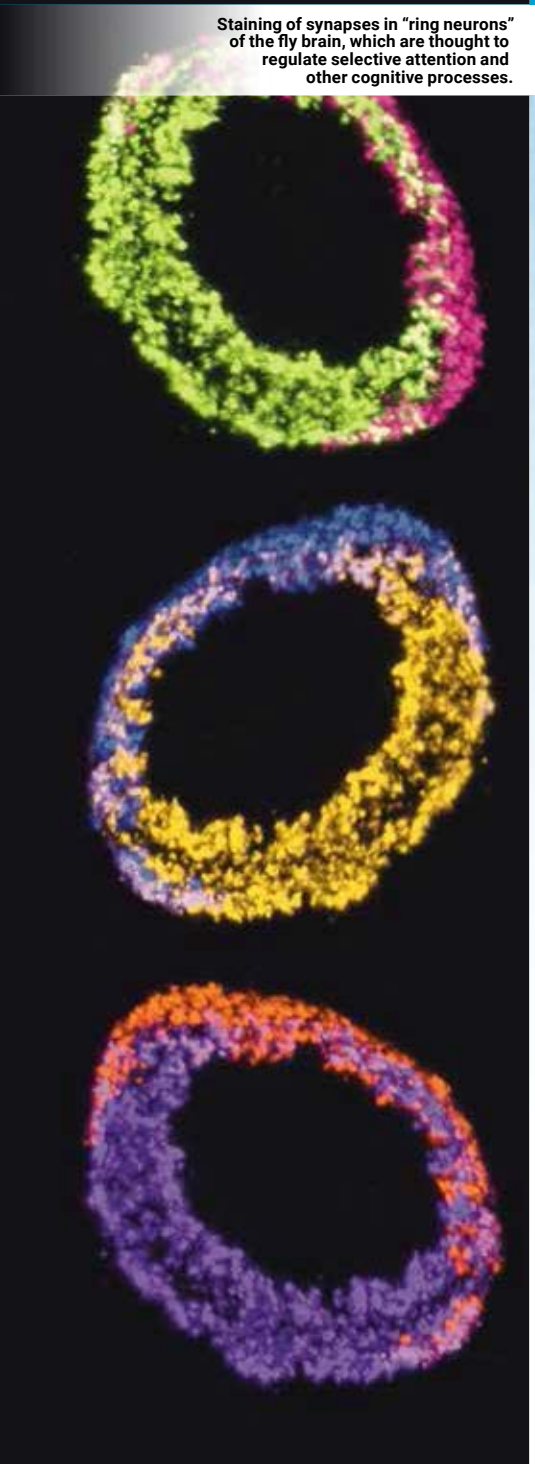
When navigating through cluttered environments, flying organisms continually face the challenge of selecting safe, collision-free routes. Studies have been conducted to investigate how bees choose between alternative routes by offering them a choice between two apertures through which they can fly to reach a food source. When the apertures are equally wide, some individuals display random choices, while other individuals display a clear left- or right-bias, depending upon the individual. These findings demonstrate, for the first time, that even insects can demonstrate individually varying "handedness". They also provide novel insights into the strategies that a swarm of bees might use to move efficiently through dense foliage.

In another study, conducted in collaboration with Boeing Defence Australia and the Queensland University of Technology (QUT), the lab is investigating biologically inspired strategies for the avoidance of mid-air collisions. High-speed video footage of budgerigars flying past each other is providing information about the guidance laws that could potentially be applied to automatically avert mid-air collisions in aircraft.

The Biorobotics laboratory has developed algorithms for (1) visually guided long-range navigation, based on honeybee navigation; (2) detection of moving airborne objects; and (3) pursuit and interception of moving objects, based on the group's studies of aggressive bees.

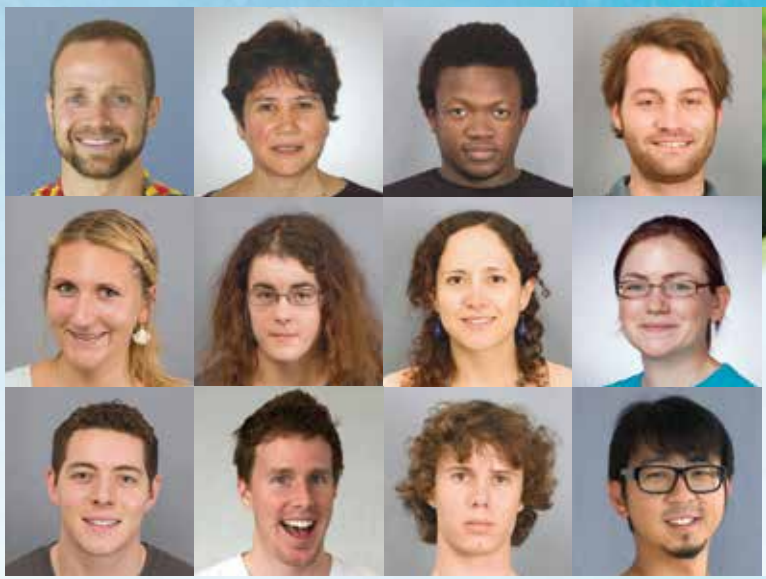
This research is funded by three ongoing research grants: (1) an ARC Discovery grant, in collaboration with QUT, to investigate the tracking of moving targets by aggressive bees; (2) an ARC Linkage grant, in collaboration with QUT and Boeing, to investigate mid-air collision avoidance in birds; and (3) an ARC Discovery Outstanding Researcher Award to study the perception of pain in invertebrates.

A honeybee feeds from a sucrose feeder located in a chequered flight tunnel.



Staining of synapses in "ring neurons" of the fly brain, which are thought to regulate selective attention and other cognitive processes.

Laboratory head **Associate Professor Bruno van Swinderen**



2015 laboratory members L–R/T–B: Bruno van Swinderen, Kathy Asmussen, Adekunle Bademosi, Lachlan Ferguson, Martyna Grabowska, Rhiannon Jeans, Leonie Kirszenblat, Aoife Larkin, James Steeves, Michael Troup, Matthew Van De Poll, Melvyn Yap. **Image:** A tethered fly walks on a trackball controlling an object on a digital display.

Drosophila behaviour and cognition

The van Swinderen laboratory uses the fruit fly model *Drosophila melanogaster* to investigate perception and cognition. By combining powerful molecular genetic tools with high-throughput behavioural assays and electrophysiology, the group is able to study the underpinnings of complex phenomena such as selective attention, memory, general anaesthesia, and sleep in the simpler fly brain. To pay attention, learn, and sleep, a brain must be able to suppress parts of the outside world effectively. Understanding how this suppression mechanism works is a central question of the laboratory, with a focus on visual systems.

Although sleep and attention might seem very different to us, it is possible that both phenomena involve similar plasticity mechanisms in the brain. This hypothesis, which guides several projects in the lab, was published as an opinion piece in *Trends in Neurosciences*. In relation to this, recent work done in collaboration with colleagues from the USA (Washington University, St Louis) found that artificially induced sleep is able to restore behavioural plasticity to *Drosophila* learning mutants (published in *Current Biology*). The lab is currently investigating how sleep and attention regulate each other in the fly brain.

To better understand attention-like mechanisms in the brain, the van Swinderen laboratory has developed several novel paradigms that allow brain recordings in walking flies as they make decisions. These paradigms, published in *The Journal of Experimental Biology*, allow tracking of visual choices in virtual reality. The group is now also able to record from multiple channels across the fly brain in these behavioural paradigms. In work published in *The Journal of Neuroscience* this year, the group found that active control increases coherence across the fly brain, compared to when flies are not in control. This has important implications for understanding how brains pay attention, and how sleep may be necessary to maintain optimal attention mechanisms.

Laboratory head **Professor Peter Visscher**

2015 laboratory members L–R/T–B: Peter Visscher, Marie-Jo Brion, Guo-Bo Chen, Anita Goldinger, Alexander Holloway, Irfahan Kassam, Luke Lloyd-Jones, Allan McRae, Gerhard Moser, Joseph Powell, Matthew Robinson, Philip Robinson, Sonia Shah, Konstantin Shakhbazov, Peter Smartt, Costanza Vallerga. **Image:** Combining genetic and epigenetic data for prediction.

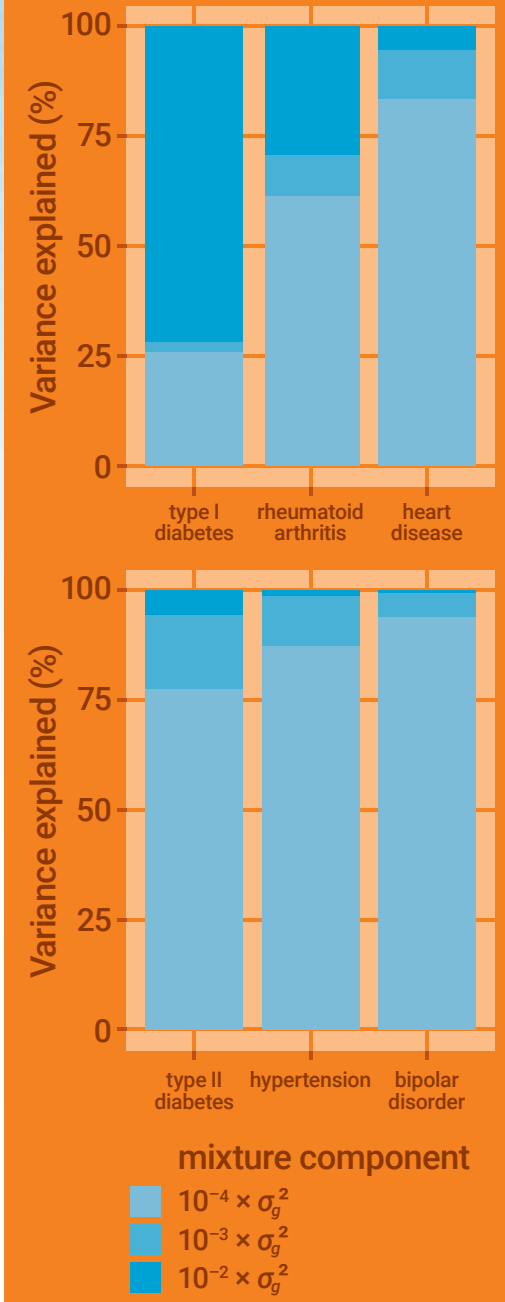
Statistics of genomes applied to common traits and diseases

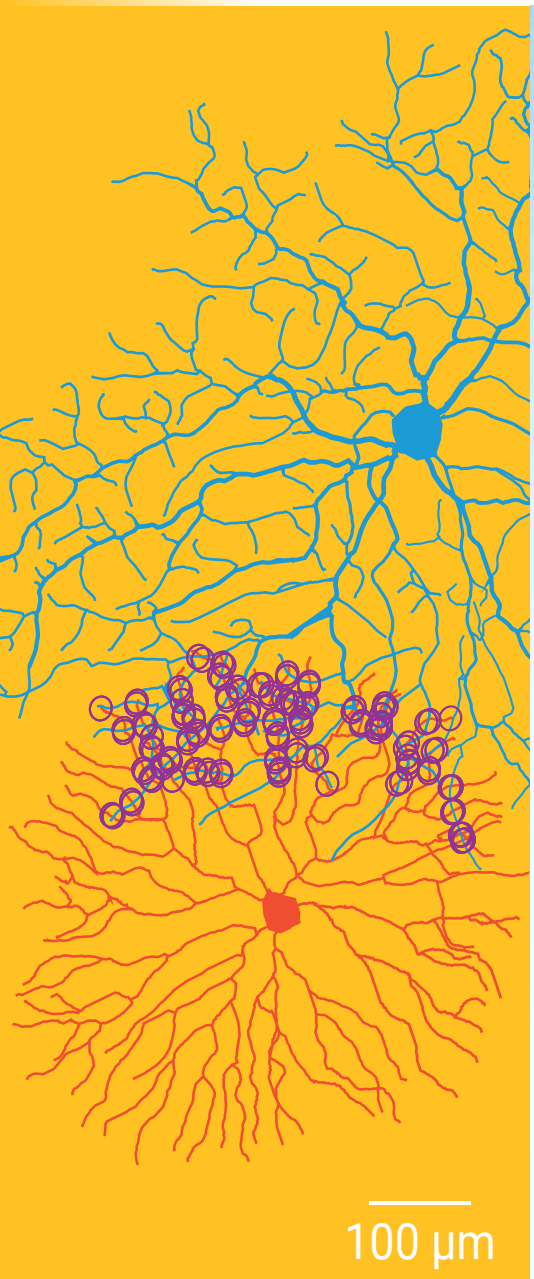
The Visscher laboratory, within the Centre for Neurogenetics and Statistical Genomics, specialises in developing methodology that enables analyses aimed at understanding the genetic basis of differences in risk for disease, and other phenotypes between individuals. This research crosses the boundaries of quantitative and statistical genetics, population genetics and human genetics. Applications are diverse but include the study of cognition, cognitive change, and psychiatric and neurological disorders. In the era of big data in genomics, a key first challenge is understanding the questions that the data can deliver. The group uses theoretical derivations, simulation studies and advanced statistical analysis. Key outputs from the Visscher lab are new methodologies and software tools.

Research highlights of 2015 include new methodologies for disease risk prediction (Moser *et al.*, 2015), a unified framework for understanding sampling variances of genetic data (Visscher & Goddard, 2015) and a suite of papers on epigenetic epidemiology, led by postdoctoral researcher Dr Riccardo Marioni, who splits his time between the Visscher lab and the lab of Professor Ian Deary (University of Edinburgh), working on the Lothian Birth Cohorts and demonstrating epigenetic associations measurable in blood that are associated with cognitive and physical ageing.

The Visscher group's research often uses model complex traits, such as height and body mass index, that are available on the largest sample sizes to demonstrate proof of principle. For example, the group published predictors of a phenotype from both genetic and epigenetic data (Shah *et al.*, 2015) and demonstrated how genetic effects can together lead to differences between populations, differentiating between drift and selection (Robinson *et al.*, 2015). The group's extensive experience in epigenetics led to a new study of Parkinson's disease, initiated in collaboration with Professor George Mellick (Griffith University) and Dr Toni Pitcher (New Zealand Brain Research Institute).

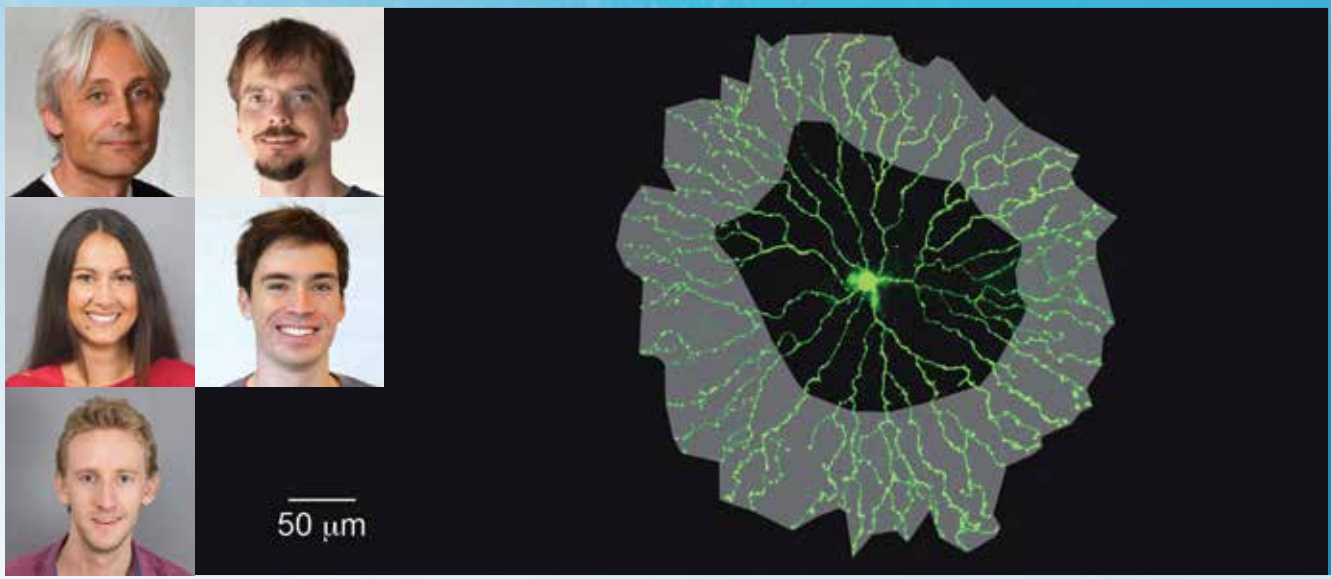
A new statistical tool for deciphering the genetic architecture of diseases.





Dendro-dendritic contacts (purple) between a retinal ganglion cell (blue) and an interneuron (red).

Laboratory head **Professor Stephen Williams**



2015 laboratory members L–R/T–B: Stephen Williams, Arne Brombas, Florence Cotel, Lee Fletcher, Simon Kalita-de Croft. **Image:** Confocal image of a retinal interneuron. The grey area shows the synaptic output zone.

Neural circuit computations

The algorithms underlying brain computations are embedded in the connectivity of neuronal networks, and implemented by the functional operations of component synapses and neurons. The Williams laboratory is investigating how neuronal circuit-based computations are implemented in the central nervous system. They use advanced electrophysiological and optical techniques to mechanistically dissect physiologically engaged computations in the retinal and neocortical micro-circuitry. Pioneering work has revealed that neuronal circuit computations occur in the fine tree-like dendritic arbours of central neurons, a finding that demonstrates that the fine-scale interplay between network connectivity and sub-cellular information processing lies at the heart of brain computations.

Ongoing work in the laboratory is aimed at discovering the circuit elements that drive and control physiologically engaged dendritic information processing. For example, the group's recent work has demonstrated that active dendritic integration in the output neurons of the neocortex is strongly modulated by the cholinergic system, providing a plausible candidate mechanism for attentional processing. Furthermore, in the retina they are dissecting the functional impact of the co-release of neurotransmitters from interneurons on the control of network computations, in order to better understand visual processing.

Laboratory head **Professor Naomi Wray**

2015 laboratory members L–R/T–B: Naomi Wray, Earlene Ashton, Beben Benyamin, Enda Byrne, Jake Gratten, Anjali Henders, Zhijun Liu, Robert Maier, Divya Mehta, Natalie Mills, Jennifer Pavlides, Wouter Peyrot, Restuadi Restuadi, Maciej Trzaskowski, Anna Vinkhuyzen, Hasti Ziaimatin. *QBI Bioinformatics Core:* Zong-Hong Zhang, Qiongyi Zhao.

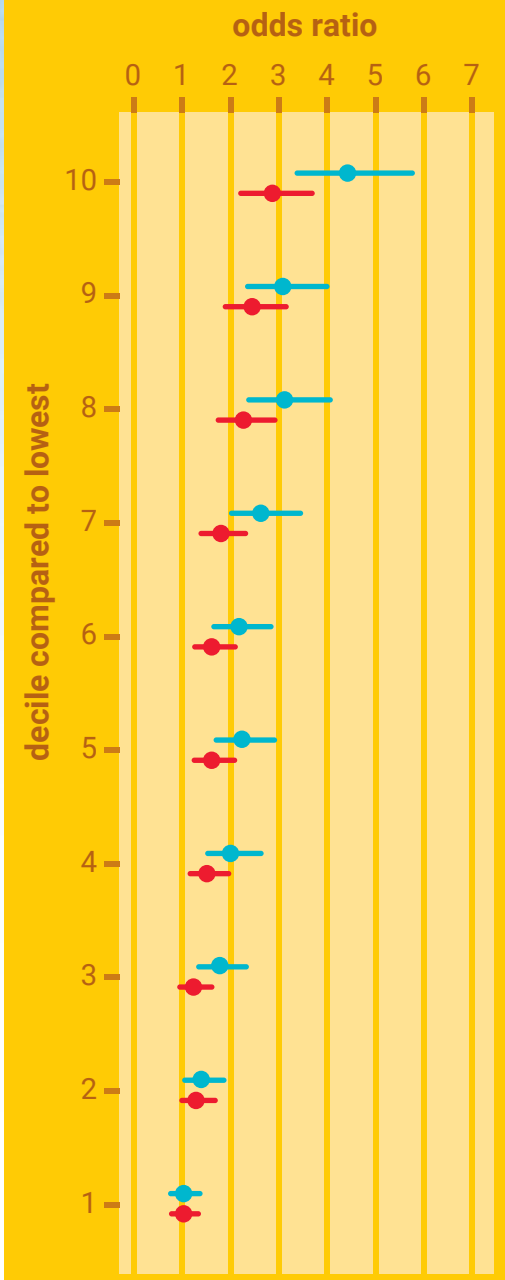
Genetics and epigenetics of psychiatric and neurological disorders

The Wray laboratory, within the Centre for Neurogenetics and Statistical Genomics, focusses on understanding the genetic contribution to psychiatric and neurological disorders. The group specialises in applying new analytical methods of genomic data to provide insights into these complex disorders, with an ultimate goal to improve diagnosis, prognosis and treatments. A key new direction of the lab is systems genomics epidemiology, the study of DNA code and epigenetic variants in large samples.

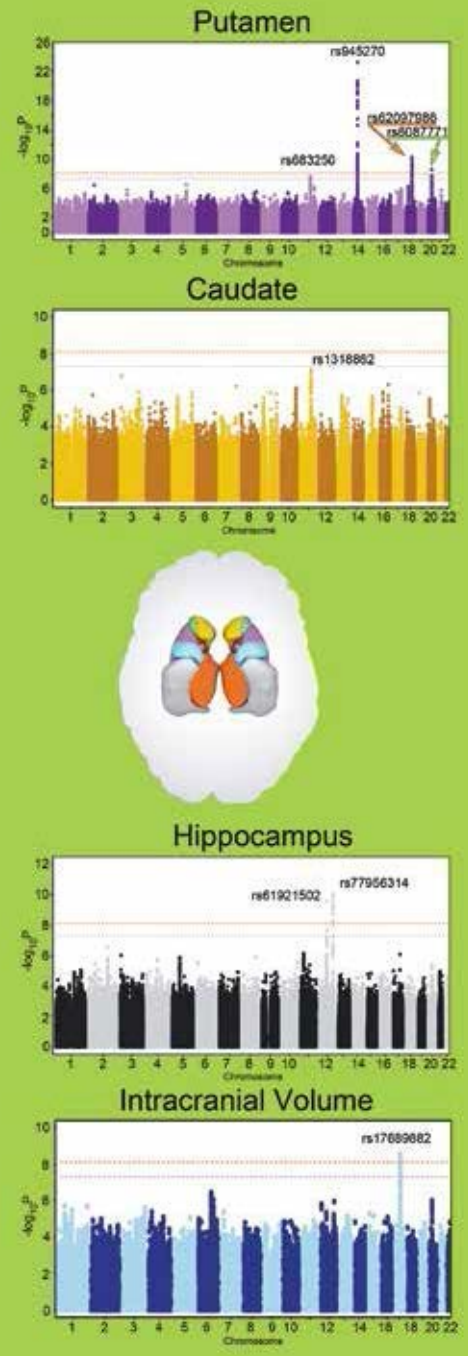
The Wray lab co-authored over 20 publications in 2015, leading work on diverse topics from stroke genetics (Holliday *et al.*, 2015) to the association of epigenetic ageing with all-cause mortality (Marioni *et al.*, 2015). In Lee *et al.*, 2015, the group examined the epidemiological conundrum that the risk of rheumatoid arthritis is lower in those with schizophrenia, despite the high smoking rates, a major risk factor for rheumatoid arthritis. They reported evidence that coding and regulatory variants are negatively correlated for risk of the two disorders. A study led by postdoctoral researcher Dr Hong Lee and PhD student Robert Maier explored how genetic information shared between psychiatric disorders can be used to improve genetic risk prediction of a disorder. The work was listed as one of the seven "Best of the American Journal of Human Genetics" papers for the year.

Major grant success includes an NMHRC Project Grant and Brain & Behaviour Foundation New Investigator Award, both awarded to Dr Jake Gratten; a research agreement to establish a systems genomics project with the CRC (Co-operative Research Centre) for Living with Autism Spectrum Disorders; and The Ice Bucket Challenge Grant for ALS motor neurone disease (MND), awarded by MND Research Institute Australia. This funding for ALS has resulted in the lab working very closely with the ALS research clinicians Professor Pamela McCombe and Associate Professor Robert Henderson from the Royal Brisbane and Women's Hospital. Facilitated by human studies manager Ms Anjali Henders, the grant funding means that the group is now establishing a wet laboratory to undertake biobanking and genomic analysis of human samples.

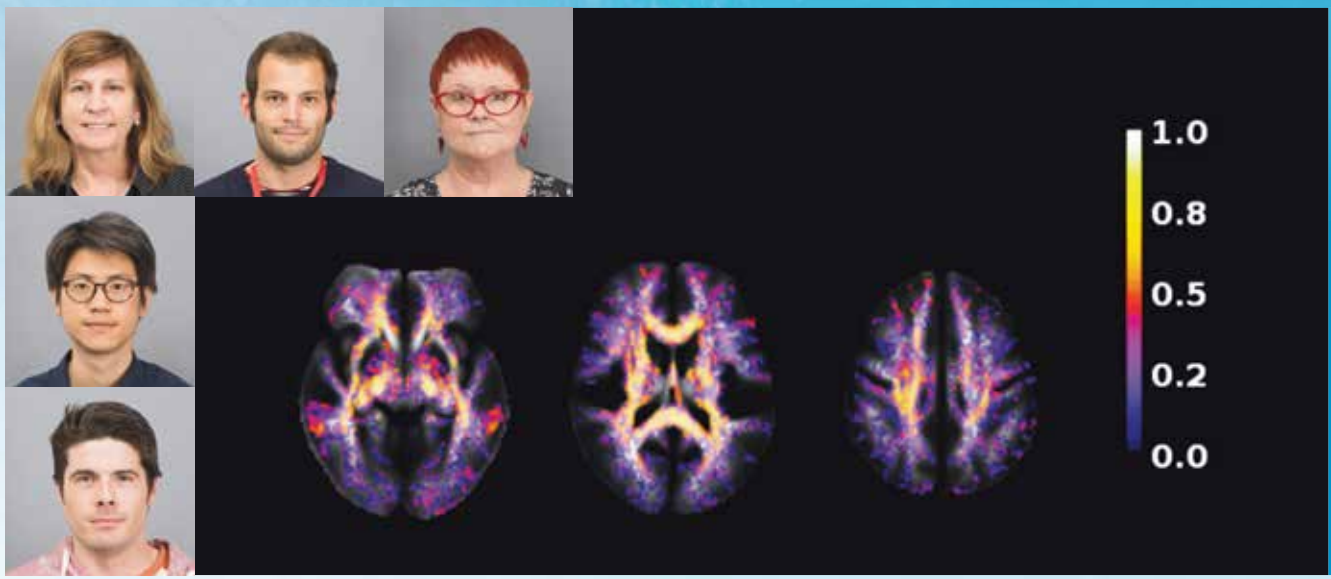
The prediction of bipolar disorder (red) is enhanced by including data from schizophrenia patients (blue).



Novel genetic variants influencing the putamen and caudate nucleus, and replication of findings for hippocampal and intracranial volume.



Laboratory head **Associate Professor Margie Wright**



2015 laboratory members L–R/T–B: Margie Wright, Baptiste Couvy-Duchesne, Narelle Hansell, Daniel Hwang, Lachlan Strike. **Image:** Genetic influence (heritability) on the white matter microstructure of the brain.

Understanding brain function and disease using imaging and genetics

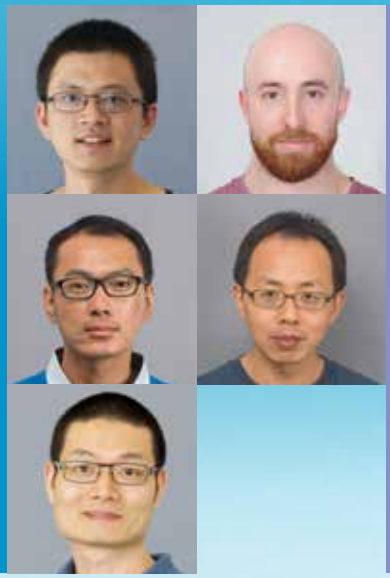
The Wright laboratory, within the Centre for Neurogenetics and Statistical Genomics, focusses on the neurobiological causes and modifiers of brain function, and especially brain disorders. Brain imaging, neuropsychological tests, and behavioural and molecular genetic approaches are used, and a vast dataset of imaging, clinical, and genetic information has been collected from people at different ages. The group investigates the genetic and environmental factors that lead to differences between individuals in the shape and size of brain structures, brain wiring and connectivity. Key aims are to understand differences in the healthy brain, to provide insights into deviations from normal development and ageing, and to increase the understanding of the biological processes at the core of illness risk for psychiatric and age-related brain disorders.

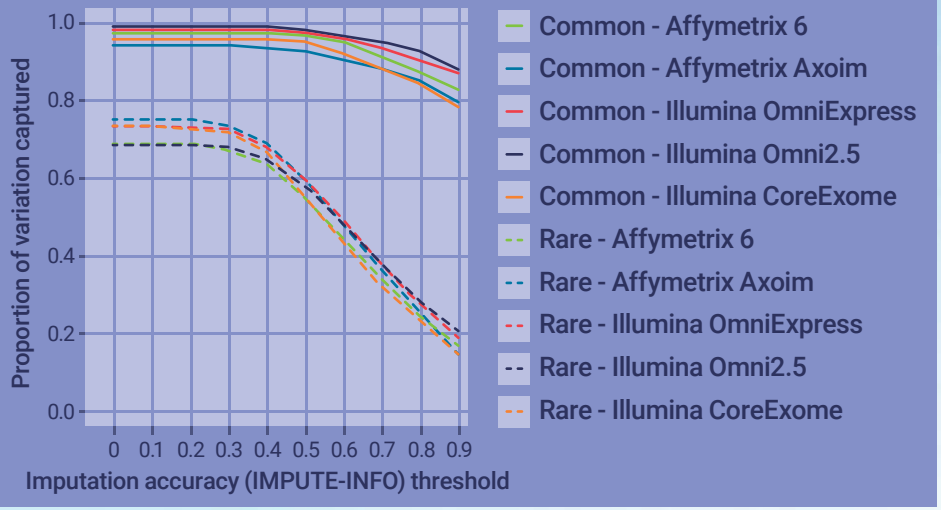
A highlight in 2015 was the collaborative work with the ENIGMA consortium, in which the largest genome-wide association study of subcortical brain volumes, including genome-wide scans and MRI scans from 30,717 people, was performed (Hibar *et al.*, *Nature*, 2015). Five novel genetic variants associated with differences in the volumes of the putamen and caudate nucleus were identified, and earlier findings for variants influencing hippocampal and intracranial volume were confirmed. In other collaborative work including data from the Human Connectome Project, progress was made in understanding the genetic influence on fractional anisotropy (FA). FA is a measure of white matter microstructure, derived from diffusion tensor imaging, and is used to track differences in white matter.

New funding from the National Health and Medical Research Council will enable the group to track the dynamic changes in the brain through adolescence. A key aim is to determine whether there are particularly sensitive periods when genetic and environmental factors alter the developmental trajectory in adolescence, and mediate risk for mental illness. Adolescence is a risk period for the emergence of psychiatric disorders.

Laboratory head **Associate Professor Jian Yang**

Research groups





2015 laboratory members L–R/T–B: Jian Yang, Andrew Bakshi, Yang Wu, Futao Zhang, Zhihong Zhu. **Image:** A large proportion of variation at sequence polymorphisms can be captured by imputation regardless of the types of SNP arrays used.

Genetics and genomics of human complex traits

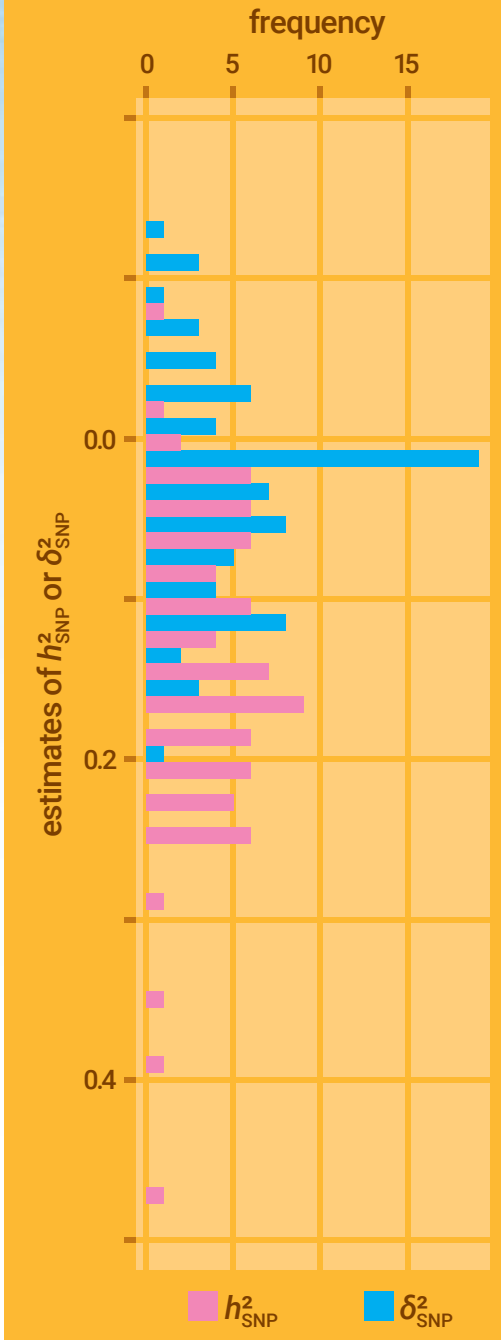
The Yang laboratory, within the Centre for Neurogenetics and Statistical Genomics, works on the interplay of genetics, genomics, statistics and computer science. The group's research focusses on developing new statistical methods and performing large-scale analyses of high-throughput genetic and genomic data to understand the genetic architecture of complex traits in humans, with specific interests in model traits such as height, and common diseases such as obesity and schizophrenia. As demonstrated by the number of citations, the methods and software tools developed by the group have been widely used in the research community for a range of complex traits and diseases.

The importance of dominance variation to complex trait variation is a long-standing question in the field of human genetics. Recently, it has been hypothesized that dominance variation could be an important source of missing heritability. The Yang group proposed a novel method that is able to estimate dominance variation in unrelated individuals using genome-wide single nucleotide polymorphisms (SNPs) data (Zhu *et al.*, 2015, The *American Journal of Human Genetics*). They demonstrated by analyses of large data sets that, on average across all traits, dominance variance is only one fifth of additive variance, which is too small to be important to the missing heritability.

The group also proposed a novel method to estimate heritability for human complex traits in unrelated individuals, using whole-genome sequencing data (Yang *et al.*, 2015, *Nature Genetics*). They showed by intensive simulations that a study design with SNP arrays followed by imputation is more cost-effective than whole-genome sequencing for gene discovery at current prices. They further showed that the missing heritability is negligible for height and body mass index.

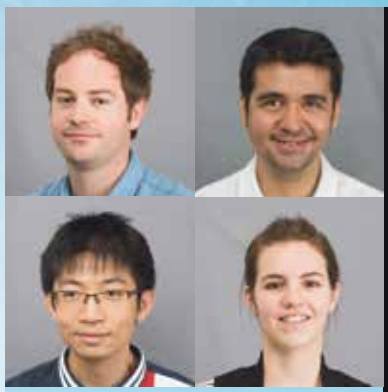
The Yang laboratory was successful in grant funding in 2015, with Associate Professor Yang awarded two ARC discovery project grants (one as CIA and one as CIB) and one NHMRC project grant (CIA).

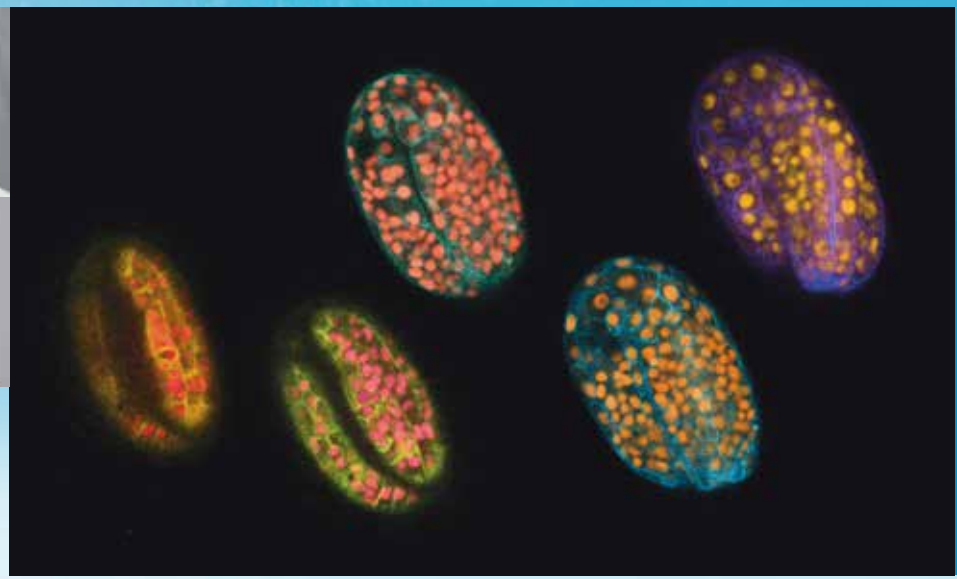
Distribution of additive (pink) and dominance (blue) variance captured by all common SNPs for 79 human complex traits.



Cell-specific promoters allow neurons to be visualised in living individuals of the model organism *C. elegans*—such as this pair of ASH chemosensory neurons, used to understand molecular mechanisms of mitochondrial damage.

Laboratory head **Dr Steven Zuryn**





2015 laboratory members L–R/T–B: Steven Zuryn, Arnaud Ahier, Chuan Yang (Michael) Dai, Andrea Tweedie. **Image:** Expression of the epigenetic enzyme Jmjd3 (red–yellow) in the nucleus of cells in *C. elegans*. Cellular plasma membranes are labelled yellow–purple.

Epigenetics and mitochondrial biology in neuron survivability

With life expectancies increasing around the world, neurodegenerative disorders represent an enormous disease burden on individuals, families, and society. Two forms of cellular stress are associated with practically every single age-related neurodegenerative disease: mitochondrial dysfunction, and toxicity resulting from conformationally challenged, aggregate-prone proteins. Although direct links between these factors and human disease are sometimes elusive, it is clear that such stresses ultimately lead to a decline in individual neuron function over time.

To sustain correct function, terminally differentiated post-mitotic neurons must preserve their subtype identity, morphology, activity, and connectivity even in the presence of these chronic insults. The Zuryn lab uses cutting-edge molecular genetic techniques in the highly successful model organism *C. elegans* to understand the fundamental mechanisms neurons use to mitigate disease-related threats. The beauty of such a model is that they are able to accurately distil complex phenotypic phenomena down into single-cell and single-gene resolution.

In 2015 Dr Zuryn was awarded the Stafford Fox Senior Research Fellowship and opened his new lab at QBI in September. One of the main focuses of the Zuryn group is the emerging role of epigenetic mechanisms that help preserve correct cell function. They have recently found that specific types of histone methylation ensure robust neuronal function in the face of stressful conditions, research that was published in the prestigious journal *Science*. The team's next goal is to understand how this occurs, and to be able to predict outcomes under alternative epigenetic criteria that may influence disease progression.

The Zuryn group is also interested in understanding fundamental aspects of neuronal mitochondrial biology. To do this, they have developed novel genetic tools in 2015 that will allow them to probe neuronal responses under stresses that model stroke and dementia. They aim to develop means to protect robust neuronal function from these types of diseases.

Inside the Queensland Brain Institute.

Centres and facilities

QBI is home to dedicated research centres in important fields of neuroscience, from the genetics of brain disorders, to the way the brain learns and ages.

Our research is only possible by having access to cutting-edge facilities, some of which are the best of their kind in the world.

Clem Jones Centre for Ageing Dementia Research

THE CLEM JONES Centre for Ageing Dementia Research (CJCADR) was opened in February 2013 as a major research centre within QBI. The Centre, headed by Professor Jürgen Götz, is focussed on research into discovering disease mechanisms and preventing and treating dementias such as Alzheimer's disease.

Both the Queensland Government and the Federal Government awarded $18 million for five years as a commitment to accelerate the research towards a cure for dementia, with additional funding being provided by the Clem Jones Foundation, The John T. Reid Foundation and the Yulgilbar Foundation. The research done at CJCADR explores, at a biochemical, molecular, behavioural, electrophysiological, histological and systems level, how ageing dementia causes neurodegeneration, decline of memory and of motor functions.

Researchers from the Anggono, Bartlett, Coulson, Götz, Hu, Hilliard and Meunier laboratories conduct dementia-related research at CJCADR. During 2015 the Centre continued a recruitment program to attract additional international researchers.

Professor Götz said that the Centre was very fortunate that Dr Zhitao Hu from Harvard University joined as a Group Leader in May 2015.

"In addition, Dr Patricio Opazo from the Bonhoeffer laboratory at the Max Planck Institute of Neurobiology in Munich and Dr Rodrigo Medeiros for the University of California, Irvine will join us at the beginning of 2016," he said. "These recruitments will have synergistic effects on our research output."

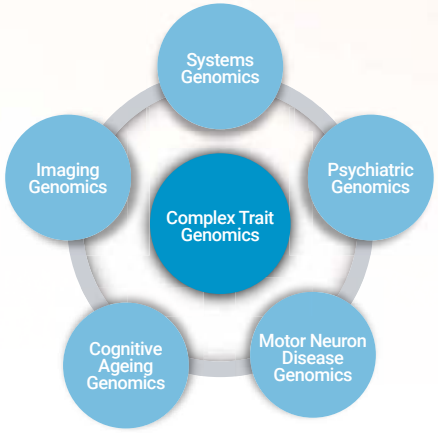
The Centre will continue to work towards reducing the burden of dementia by pursuing novel treatment strategies, including the use of ultrasound to remove toxic protein aggregates and restore memory functions. This novel strategy was published in early 2015 and is currently being explored for its translational potential.

"A major outcome is the discovery of therapeutic interventions to delay the onset of dementia and to prevent and even cure dementia in patients, using novel drugs and better methods to deliver them to the brain," Professor Götz said. "Another outcome is the development of biomarkers to diagnose dementia earlier, more cheaply and with higher sensitivity and specificity and to monitor therapeutic interventions. Lifestyle strategies will also be formulated for maintaining a healthy brain, in particular how exercise slows down cognitive decline."

Above left: There was a media storm surrounding the visit of the Queensland Premier, The Hon Annastacia Palaszczuk MP (centre), to announce a breakthrough for Alzheimer's disease treatment by CJCADR Director Professor Jürgen Götz (right) and Gerhard Leinenga (left).

Centre for Neurogenetics and Statistical Genomics

CNSG



2015 MARKED THE second year for the Centre for Neurogenetics and Statistical Genomics (CNSG) co-directed by QBI Faculty Professors Peter Visscher and Naomi Wray. Associate Professor Margie Wright became the fourth QBI Faculty member, joining Associate Professor Jian Yang.

The CNSG was established to bring together a team of researchers with expertise in neurogenetics, neuropsychiatric genetics, statistical genomics, bioinformatics and computational biology. Associate Professor Wright's research is at the interface of genetics, cognition and brain imaging, providing an important link between the genetic focus of CNSG with other imaging-focussed labs at QBI. The Centre comprises more than 30 staff who are all funded by competitive grant funding including six fellowships.

Senior researchers within the CNSG lead each of the themes, which all interface with the core theme of complex trait genomics. Complex traits are quantitative measures, diseases or disorders that are underpinned by multiple genetic and non-genetic factors. These include common diseases such as cancers and immune disorders, as well as the CNS disorders studied in the Centre. The themes of psychiatric, MND, cognitive ageing and imaging genomics are phenotype based, while the theme of systems genomics focusses on epigenetic and expression epidemiology. CNSG hosts the QBI Bioinformatics core, led by Dr Qiong-Yi Zhao.

In 2015 CNSG was awarded grants totalling more than $5 million: three ARC discovery grants (led by Visscher, Yang and Robinson), two NHMRC project grants (Yang and Gratten), a Brain & Behaviour Foundation New Investigator Award (Gratten), the Motor Neurone Disease Ice Bucket Challenge Grant (Wray), a contract with the Co-operative Research Centre for Living with Autism Spectrum Disorders (Gratten) and an NIH sub-award (Wray). This year Human Studies Manager Anjali Henders established a human studies unit for QBI, allowing the Institute to receive and process human biological samples necessary for the large number of clinical collaborations now underway. In May, a CNSG delegation (Visscher, Wray, Yang and Henders) visited Wenzhou Medical University to further a growing collaboration.

More than 70 publications were co-authored by CNSG members in 2015, who have been lead authors on papers published in top journals in the field: *Nature Genetics* (3 publications), *Nature Neuroscience*, *American Journal of Human Genetics* (2 publications), *Genome Biology*, *International Journal of Epidemiology* (2 publications). Professor Visscher was once again listed in the Thompson Reuter's Index of highly cited researchers. The reputation of CNSG is recognised through a large number of international speaking invitations on a wide range of topics—from "Genomics, Big Data and Medicine" (Visscher, Mt Sinai School of Medicine Inaugural Seminar series) to precision medicine (Wray, President's Plenary Symposium of the American Society of Human Genetics) to genomic methods (Yang, Gordon Research Conference, Italy).

Above: The CNSG team, which in 2015 expanded to four laboratory groups comprising more than 30 staff.
Left: The five CNSG research themes.

Researchers from the SLRC shared knowledge of learning and the brain with school students as part of UQ's Solid Pathways program.

Science of Learning Research Centre

SCIENCE OF LEARNING
RESEARCH CENTRE

A FOCUS OF THE Science of Learning Research Centre (SLRC) in 2015 was outreach and engagement, including a seminar series, with the education community.

Professor John Hattie's seminar, "The science of how we learn", which attracted more than 200 researchers and educators, kicked off the seminar series. This was followed by a further 10 seminars across the year, including the American Institutes for Research's Dr David Osher's presentation "Social and emotional learning and the conditions for learning" and Flinders University's Professor Martin Westwell's seminar "You are not thinking you are just being logical: creativity, executive functions and NAPLAN results".

In June, more than 80 teachers from across Queensland attended the Centre's first Professional Development Workshop held at UQ. This was extremely well received, with demand for a second follow-up workshop, held in October. These workshops were replicated at The University of Melbourne. Planning for workshops in 2016 is already well underway. The Centre was extremely fortunate to benefit from the knowledge and experience of Ms Tennille Seary, a teacher on secondment from Brisbane State High School. Ms Seary played a key role in the Research Translation Team, as well as contributing to several research projects in the Centre, including the Teacher-Student Synchronicity project, which is investigating the relationship between students and the student-teacher relationship in a classroom, led by Professor Ross Cunnington (QBI) and Professor Robyn Gillies (UQ School of Education). The SLRC thanks the Queensland Department of Education for supporting this initiative.

The Centre is extremely grateful to all the schools that have supported us throughout the year and look forward to ongoing collaboration.

The SLRC would like to acknowledge the support of the Australian Research Council and our Collaborating and Partner Organisations:

Collaborating Organisations:

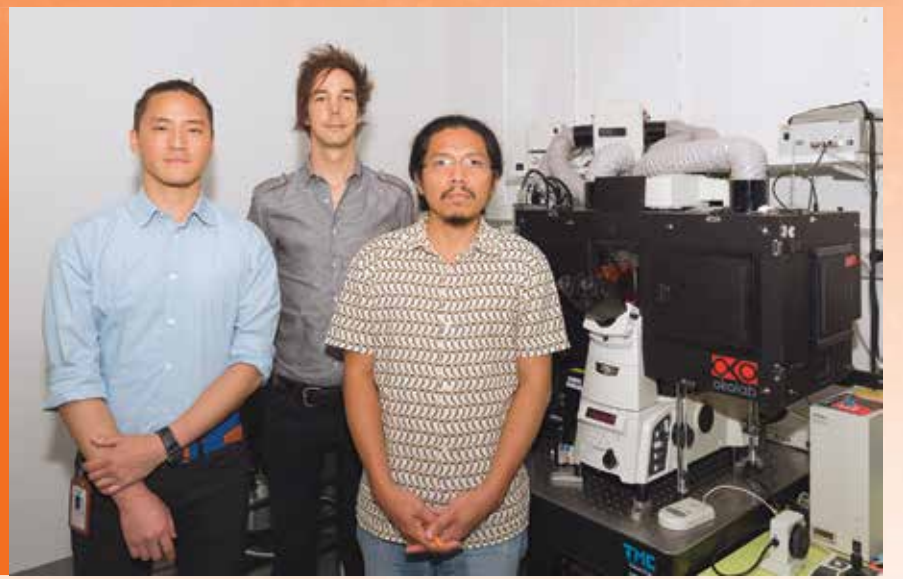
- The University of Melbourne
- Australian Council for Educational Research
- Charles Darwin University
- Curtin University
- Deakin University
- Flinders University
- Macquarie University
- University of New England

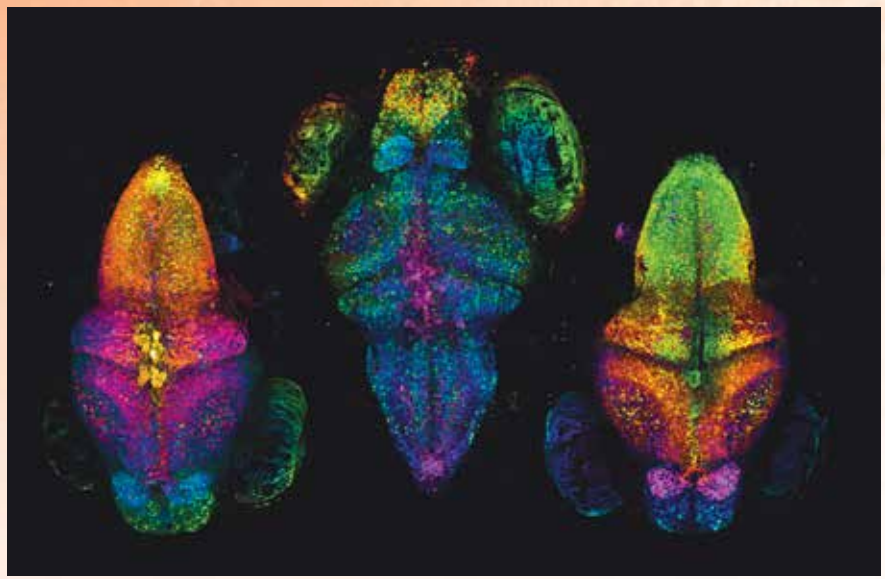
Partner Organisations:

- University College London
- University of London
- Carnegie Mellon University
- North Carolina State University
- Questacon
- Benevolent Society
- Department for Education and Child Development, South Australia
- Department of Education and Training, Victoria
- Department of Education and Training, Queensland

Above centre: SLRC theme leader Professor John Hattie (University of Melbourne) attracted a full house for his seminar "The science of how we learn". **Above right:** Researchers from the SLRC shared knowledge of learning and the brain with school students as part of UQ's Solid Pathways program.

Advanced microscopy facility





QBI'S ADVANCED MICROSCOPY facility is one of the largest and most diverse light microscopy facilities in the world. Built around 24 high-end instruments, it offers researchers at QBI access to state-of-the-art technology, leading visualisation software and experienced staff for training, support and experimental advice.

The facility's capabilities allow 3D imaging of brain tissue all the way down to sub-cellular structures within neurons. Many of the instruments have been designed to allow imaging of live neurons and organisms to facilitate the study of dynamic processes related to neuroscience research, such as axon regeneration and neuronal survival.

In 2014 QBI was awarded $1.2 million through the ARC LIEF scheme to establish a super-resolution facility. One of the first of its kind in Australia, this facility allows QBI researchers to see minute details such as individual proteins in living cells. Using super-resolution microscopy techniques, QBI researchers have already published several high-ranking peer-reviewed papers, including publications in the *Journal of Neuroscience*, *Molecular Psychiatry* and *Nature*. The Hilliard lab's publication in *Nature* used super-resolution microscopy to observe protein localisation at the plasma membrane of axons during axon regeneration. The Meunier lab was able to use similar techniques to observe the dynamic rings forming at the surface of cells during neurotransmitter release.

New work within the facility is focussed on tracking individual receptors moving within live neurons, automating the analysis of neuronal populations, mapping neuronal processes in the developing brain and quantifying synapse numbers. Advancements in imaging speed mean the data produced is too large to be analysed without computationally intensive processing. For this reason, the microscopy facility has worked closely with information technology staff to bring online new servers for image analysis and image storage and sharing. The latter allows QBI researchers access to their data from anywhere in the world.

The facility plans to extend its capabilities into the area of light-sheet imaging, a method that will allow QBI researchers to image entire brains at sub-cellular resolution at extremely high-speed. This technique will allow researchers to map out the activity of individual neurons in living brains and create 3D maps of entire neuron populations within the brain.

Above left (L–R): Advanced microscopy facility staff Arthur Chien, Luke Hammond (Manager) and Dr Rumelo Amor next to a super-resolution microscope. **Above right:** Neuronal cell bodies within the brain of three separate zebrafish. Imaged using a spinning disk confocal microscope, and coloured depending on the depth in the brain. Each brain is comprised of 5000 separate image files, with the three brains totalling approximately 100GB of data. While the images only take a few minutes to capture, recombining and analysing them is an emerging challenge for neuroscientists. Imaged by Dr Jeremy Ullmann, combined and processed by Luke Hammond.

Animal house and behavioural suite

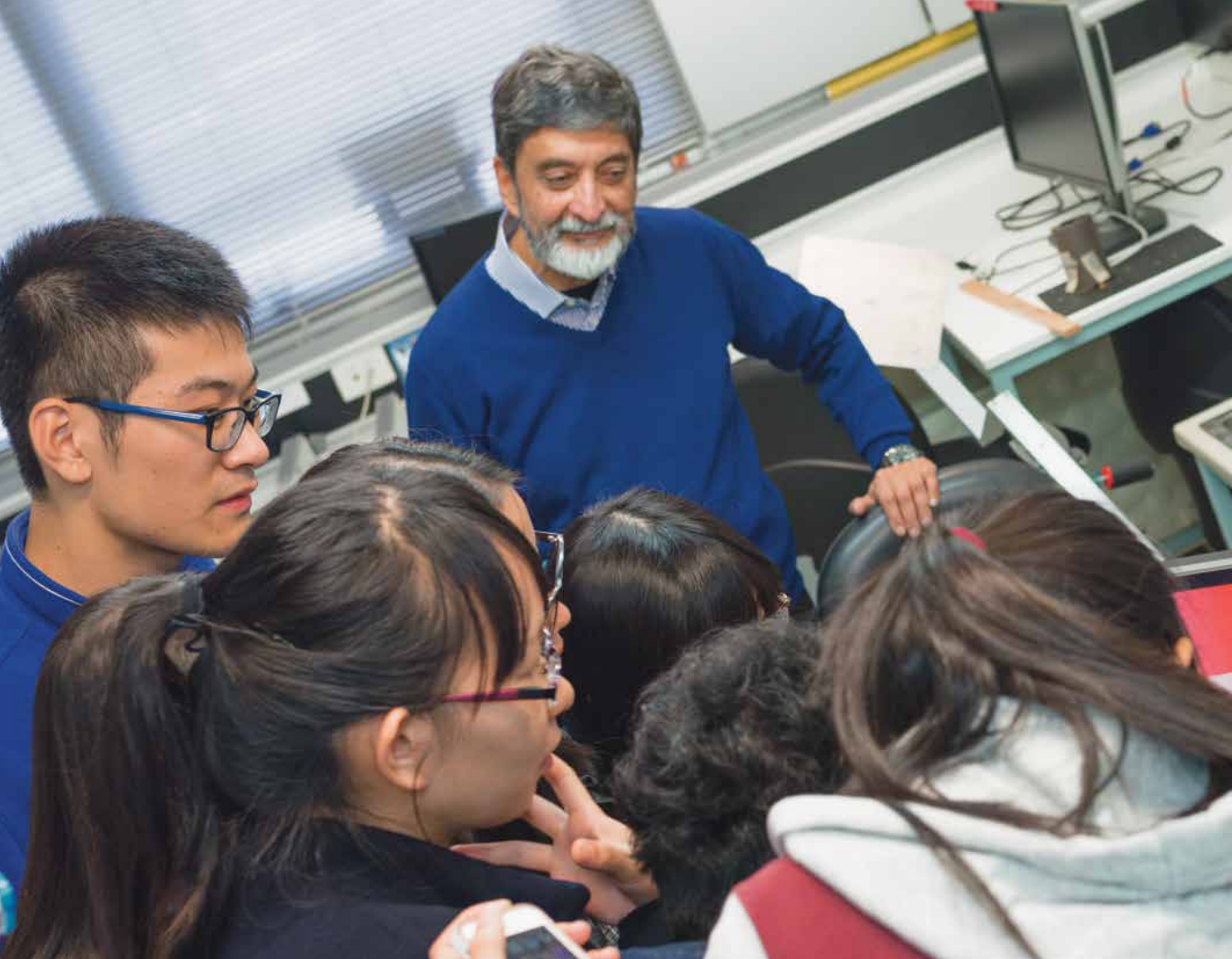
QBI'S ANIMAL HOUSE is much more than just a simple area where animals are bred or kept until needed by the researchers. It houses more than 11,000 animals that have been derived from more than 230 genetically modified lines.

To answer the exceptionally complex questions researchers are asking requires the manipulation of genes to create models that mimic the brain in both a diseased and healthy state. To create these animals requires a lot of time, energy and understanding of the processes involved. The animal house facility has 12 full-time staff members. These dedicated staff are actively engaged with researchers to ensure they get the type of model they need for their essential research. Staff also help with proper colony management, best breeding practices and establishment of novel genetically modified lines. The facility conducts best practice for every aspect of animal welfare with constant monitoring of animals, special diets where needed and excellent animal husbandry methodologies employed to ensure all animals are cared for to the highest standard. These animals are the corner-stone for the majority of the studies conducted within the Institute and are treated with the utmost respect. Every aspect of the facility is designed to ensure consistency and this includes temperature, humidity, air quality and light cycle.

Tissue and blood collection, minor surgical procedures and training new staff and students in basic animal handling procedures are also part of day-to-day operations. With so many years of experience readily on hand, this is usually the first place most researchers contact to establish their experimental model of choice.

The animal house also contains the Animal Behavioural and Surgical Facility. This Facility allows researchers to investigate a large range of behavioural characteristics, ranging from simple motor function to complex memory and learning abilities. Twelve rooms are dedicated to rodent behaviour, allowing researchers to undertake more than 40 behavioural tests and procedures. Many of these are the most up-to-date behavioural tracking programs available. This results in accurate and rapid analysis of behavioural outcomes. The facility also contains behavioural paradigms that utilise touch-screen technology for rodent behaviour that allows for translation between animal and human studies.

Above left: Computerised, motor driven stereotaxic equipment that can be utilised to conduct microsurgery on rodents. This equipment allows for even greater accuracy of surgery for the researchers at QBI. **Above right (L–R):** Some of the dedicated animal house staff: Brodie Quine, Katherine Meyer, Trish Hitchcock (Centre Manager), Morgan Leigh, Danielle Kendrick, Liesel Macdonald, Danielle Eastley, Kit Yee Leung, Michael Berg and Daniel Blackmore. *Not pictured:* Kim Woolley, Robyn Rachow, Michael Lutkins and Maryam Ashrafi.



Professor Mandyam Srinivasan takes a visiting student group on a tour of QBI's Biorobotics laboratory.

Mentorship

QBI provides world-class research training not only for students, but scientists at all stages of their careers.

The Institute is strongly committed to the mentorship and career development of Honours, Masters and PhD students as well as postdoctoral and professional research staff.

Professor Huajin Tang
2006–2008

WHEN I FIRST came to the Queensland Brain Institute, I had a strong desire to pursue deep research brain science and computational neuroscience. After I finished my PhD in electrical and computer engineering at the National University of Singapore and worked as a system engineer in STMicroelectronics, I started searching for a postdoctoral position.

QBI seemed to be a good match with my interests in the close interaction between experimental neuroscience research and computational neuroscience, and a daily routine of discussions and interactions with neuroscientists. I found Professor Geoffrey Goodhill's laboratory had a postdoctoral position available and thanks to this I had the opportunity to work at QBI.

The thing that stays with me most about QBI is its distinct focus on brain research: to understand how the brain works through a wide spectrum of research labs doing research in a range of areas, including computation and neural circuits, neuroimaging, synaptic function and cognition. QBI has very sophisticated scientific facilities and equipment, and also a robust scientific atmosphere and exciting research directions. Of course, I also like the quiet and beautiful St Lucia campus where QBI stands. QBI is a solid brand, a big name in brain science in the world and a wonderful organisation for researchers.

QBI equipped me with a good scientific vision, rich knowledge and a strong interest in understanding how the brain works. I appreciated the postdoctoral training in Professor Goodhill's lab, where I started to grow as an independent and aspiring young researcher. After leaving QBI, I returned to Singapore to join the Institute for Infocomm Research (I^2R), and started to set up my own research group and lab, the Cognitive Computing Group, which was the first I^2R group to focus on brain-based computing. My training at QBI was of great benefit when it came to doing cutting-edge cross-disciplinary research, namely neuromorphic computing. My research group has received various international acclaims and awards: we developed an artificial brain-GPS algorithm for robots based on the 2014 Nobel-prize winning discoveries of place cells and grid cells, which was reported by MIT Technology Review in 2015 (A robot finds its way using artificial "GPS" brain cells) as making significant progress in neuromorphic research. Our research on "Rapid Feedforward Computation by Temporal Encoding and Learning with Spiking Neurons" was selected by the IEEE Computational Intelligence Society to receive the Outstanding TNNLS Paper Award in 2016. I have served in various positions on international conferences and journals, such as Program Chair of 7th IEEE International Conference on Cybernetics and Intelligent Systems (CIS-RAM 2015), and Associate Editor of *IEEE Transactions on Neural Networks and Learning Systems*, and Associate Editor of *IEEE Transactions on Cognitive and Developmental Systems*.

I am now a professor at Sichuan University, Chengdu, China. Sichuan University is among the top 10 universities in China, and I am heading the Neuromorphic Computing Research Center (NCRC) in the College of Computer Science. In the centre I train young research students to conduct research ranging from computational neuroscience, neuromorphic computing to intelligent robots.

My plan is to continue to make "delivering high-quality research" as my objective, and also to lead the NCRC to being its own "solid brand" within 10 years. There is still a long way to go but I am moving in the right direction. I am also looking forward to exploring collaborative opportunities with QBI researchers. As a QBI alumnus, I would welcome QBI researchers to Chengdu, a beautiful city and home of the giant panda.

As Confucius says: "What a pleasure to have a friend come from afar."

QBI alumni

Dr Kaylene Young
2003–2004

I JOINED QBI in early 2003, and was one of the people there at the beginning to help establish the Institute and get it going. In the 18 months I was there, the Institute grew from about 10 people to around 30, and more labs were relocating, so there was this sense of progress, and it was a pretty exciting time to be involved.

In 2003 we were carrying out our experiments in renovated laboratory space on the UQ campus, and when I left to start my postdoc at University College London in 2004, the foundations of the new building had just been poured. I had seen the architectural drawings, but it wasn't until I was back in Australia a few years later that I got to see the finished building. I was excited by the large number of people working inside, and I was happy to see that the whole project was a success.

I am now head of the Glial Research Team at the Menzies Institute for Medical Research in Hobart, Tasmania, where my group primarily focuses on identifying ways to improve brain repair. We are also interested in developing new therapies for the treatment of multiple sclerosis, dementia and mental health disorders.

The thing I remember the most about my time at QBI is the people. They became my second family. But I also remember some of the more animated scientific discussions. The Institute was made up of a small number of people from very different research backgrounds, obviously all neuroscience, but different areas of neuroscience. Those discussions made me realise that it can be good to argue in science. It actually leads to helpful collaboration and makes the experiments better.

From the early stages of my career, the scientific connections that I made at QBI have really helped my career. When I returned from overseas they played a big part in helping me settle back into the Australian research environment.

Right now I am focused on my own personal research goals, and in the next 10 years I hope to have successfully translated some of my basic biological findings into the clinic. I am also very invested in my team, and hope to see my current lab members pursue and achieve their own career goals. Ten years goes by pretty quickly in science, and I hope to have taken on more senior roles to allow me to get more involved in shaping the broader research agenda.

Postgraduate students

IN 2015, QBI continued its highly successful national and international recruitment programs for research higher degree students.

QBI had 101 enrolled candidates, with 99 PhD students and two MPhil students, including 43 international students from 18 countries. The total enrolment figure also included 22 new students—nine domestic students (seven PhDs and two MPhils) and 13 international PhD students.

QBI was also honoured to confer 16 PhDs in 2015, adding invaluable knowledge to the world's neuroscience bank: **Lavinia Codd** (Bartlett); **Georg Kerbler** (Coulson); **Gavin Taylor** and **Aymeric Denuelle** (Srinivasan); **John Morris** (Sah); **Hanne Thoen** (Marshall); **Oscar Jacoby** (Mattingley); **Elizabeth Kita** (Goodhill); **Andrew Martin** and **Chikako Ragan** (Mowry); **Oressia Zalucki** (van Swinderen); **Danay Baker-Andresen** (Bredy); **Sahil Talwar** (Lynch); **Daina Dickins** (Kamke); **Xianfeng Yang** (Jiang); **Paola Spadaro** (Widagdo).

Some of our student alumni have stayed to continue their research at QBI while others have taken their knowledge to other laboratories across the world.

Scholarships enable many of our RhD students to work and study at QBI and the 2015 highlights included **Debajyoti Karmaker** and **Mahadeeswara Mandiyam** (Srinivasan), who each won a $14,150 p.a. Boeing Top Up scholarship. **Alejandra Lopez-Galan** (Marshall) was awarded a CONACYT (Mexican National Council for Science and Technology) Living Allowance Scholarship and a UQI Partial Tuition Fee Scholarship. The following candidates were successful in being awarded an International Postgraduate Research Scholarship in conjunction with a UQ Centennial Living Allowance and they were also awarded the QBI Top Up: **Md Moniruzzaman** (Meunier); **Michael Howarth** (Vukovic); **Jan Moelter** (Goodhill); **Deniz Ertekin** (van Swinderen).

Above: The QBI Student Association invited Professor Carol Ann Mason as keynote speaker for the 2015 Postgraduate Student Symposium. L–R: Laura Morcom, Gonzalo Almarza, James Fraser, Carol Ann Mason, Alessandra Donato.

Other notable scholarships were received by **Yuanzhao Cao** (Meunier), who was awarded the China Scholarship Council (CSC) Living Allowance and the UQI Tuition Fee Scholarship, while **Nanthini Jayabalan** (Coulson) was awarded a JPA (Malaysian Government) Scholarship.

Other student successes in 2015 included:

- **Gerhard Leinenga** (Götz), who featured in a news story about a breakthrough in dementia research
- **Gerhard** was also the winner of the Sigma-Aldrich $500 Publication Prize for the best published paper in 2015, selected by the QBI RHD Committee
- **Anna Bode** (Lynch), awarded the 2014 Dean's Award for Outstanding Research Higher Degree Thesis
- **Baptiste Couvy-Duchesne** (Wright), who was awarded the Australian Centre of Excellence in Twin Research (ACETR) Travel Grant Scheme
- **Casey Linton** (Hilliard), won the School of Medicine Dean's Award for Best Poster at SOM Medical Student Research Conference 2015
- **Luke Hearne** (Mattingley), **Vinod Narayana** (Meunier) and **Natalie Rens** (Cunnington), awarded Graduate School International Travel Awards
- **Toni Turnbull** (Coulson), awarded a poster presentation prize at the 6th International Postgraduate Symposium in Biomedical Sciences
- **Yajie Sun** (Sah) received the Sir Grafton Elliot-Smith Award for the best poster by a Student Member of ANS
- **Alessandra Donato** (Hilliard), awarded the Best PhD Project Presentation at the 2015 Australian Brain Bee Challenge Queensland Final

The QBI Student Association continued to add vibrancy and scientific diversity to the Institute, hosting and presenting a range of events and seminars, including the second QBI Postgraduate Student Symposium in December, with Professor Carol Ann Mason from Columbia University's Department of Pathology and Cell Biology as keynote speaker. During this event, **Vinod Narayana**, **Huyen Nguyen**, **Natalie Groves** and **Sarah Hunt** presented plenary lectures on their research findings, while **Ming Soh**, **Siân Baker**, **Aung Aung Kywe Moe**, **Rachel Templin** and **Toni Turnbull** presented short talks on their research. Students were judged on their presentations and prizes were awarded to **Sarah Hunt** for best long talk and **Toni Turnbull** for best short talk.

Planning for QBI's new Master of Philosophy in neuroscience was well underway in 2015, with the program starting in February 2016. Almost 100 candidates made strong applications and eight were offered places—five domestic students and three international students.

QBI continued to host winter and summer scholars as part of the annual UQ research programs, with five international winter scholars for four to 10 weeks, and nine summer scholars for eight to 12 weeks.

In participation with UQDI, IMB and AIBN, QBI hosted five Fudan and Wenzhou Visiting Chinese Scholars for six weeks from 13 July, 2015. The chosen scholars had moderate research experience, and had expressed an interest in research/PhD study.

Graduating students

Dr Danay Baker-Andresen, PhD
PRINCIPAL ADVISOR: DR TIM BREDY
DNA methylation: an epigenetic watermark of former cocaine self-administration

Dr Lavinia Codd, PhD
PRINCIPAL ADVISOR: PROFESSOR PERRY BARTLETT
The role of neurogenesis in functional recovery in an Endothelin-1-induced model of hippocampal stroke

Dr Aymeric Denuelle, PhD
PRINCIPAL ADVISOR:
PROFESSOR MANDYAM SRINIVASAN
Bio-inspired visual homing strategies for autonomous aerial navigation

Dr Daina Dickins, PhD
PRINCIPAL ADVISOR: DR MARC KAMKE
Is plasticity in the human motor cortices altered in healthy older adults?

Dr Georg Kerbler, PhD
PRINCIPAL ADVISOR:
PROFESSOR ELIZABETH COULSON
Imaging basal forebrain dysfunction in Alzheimer's disease

Dr Elizabeth Kita, PhD
PRINCIPAL ADVISOR: PROFESSOR GEOFFREY GOODHILL
In vivo imaging of the zebrafish retinotectal map

Dr Oscar Jacoby, PhD
PRINCIPAL ADVISOR: PROFESSOR JASON MATTINGLEY
Top-down and bottom-up processes in vision

Dr Andrew Martin, PhD
PRINCIPAL ADVISOR: PROFESSOR BRYAN MOWRY
Characterizing copy number variants in schizophrenia: a clinical, neuropsychological, and neuroimaging study

Dr John Morris, PhD
PRINCIPAL ADVISOR: PROFESSOR PANKAJ SAH
The neural basis of the partial reinforcement extinction effect

Dr Chikako Ragan, PhD
PRINCIPAL ADVISOR: PROFESSOR BRYAN MOWRY
Analysis of non-coding RNA expression in schizophrenia brain

Dr Paola Spadaro PhD
PRINCIPAL ADVISOR: DR JOCELYN WIDAGDO
The role of regulatory long non-coding RNAs in adaptive behaviour

Dr Sahil Talwar, PhD
PRINCIPAL ADVISOR: PROFESSOR JOSEPH LYNCH
Identification and characterization of new synthetic drugs selectively targeting α3 glycine receptors as therapeutic leads for pain treatment

Dr Gavin Taylor, PhD
PRINCIPAL ADVISOR:
PROFESSOR MANDYAM SRINIVASAN
Unravelling the sensory control of behaviour in honeybees using virtual reality paradigms

Dr Hanne Thoen, PhD
PRINCIPAL ADVISOR: PROFESSOR JUSTIN MARSHALL
Colour vision in mantis shrimps: understanding one of the most complex visual systems in the world

Dr Xianfeng Yang, PhD
PRINCIPAL ADVISOR: PROFESSOR TIANZI JIANG
Brain shape analysis by diffeomorphic metric mapping and application in imaging genetics

Dr Oressia Zalucki, PhD
PRINCIPAL ADVISOR:
ASSOCIATE PROFESSOR BRUNO VAN SWINDEREN
Presynaptic mechanisms of general anaesthesia in Drosophila melanogaster

Annika Nichols
2011–2013

I SPENT TWO-AND-A-HALF exciting years at QBI. I started as an Honours student in 2011 with Massimo Hilliard's laboratory and then, because I enjoyed it so much, I stayed as a research assistant until the middle of 2013.

Massimo's lab uses the 1mm-long, nematode worm, *C. elegans*, as a model organism to study how nerves degenerate and regenerate. I had never seen the small, elegant creatures in real life before and I was taken by their simplicity and amenability. While these tiny creatures have far fewer than a billionth of the cells that we humans have, they are still able to perform all of the basic functions that we do, such as growing from a fertilised egg to an adult, moving, breeding, eating and sleeping. Additionally, many of the genes, proteins and pathways underlying these processes in us are very similar in the worm. In my research I tried to understand how an axon (the longest structure of a nerve cell) degenerates when it is cut or broken. Through the support and work of many others in Massimo's lab, as well as from collaborating laboratories, we were able to publish this story in the scientific journal *Cell Reports*.

QBI was a fantastic place to study and work. The building itself is physically reminiscent of a ship on a voyage into the unknown. The facilities, research and people are world class. I enjoyed the connections that QBI encouraged between scientists, departments and the public. QBI also values creativity, as shown by the many of the beautiful artworks within the building and the yearly art competition. Science, nature and discovery are beautiful.

My time at QBI, as well as my undergraduate degree at UQ, were essential for my development as a scientist and person. My years there instilled a drive to search for quality, opportunity and adventure.

In mid-2013 I moved to Vienna, Austria, to commence my PhD with Manuel Zimmer at the Research Institute of Molecular Pathology (IMP), which is a part of the Vienna Biocenter. Here, I can continue to delve into the mind of the worm, but with a more behavioural focus than before.

When I was on holiday in Brisbane in 2014, I was kindly invited to give one of the regular QBI Wednesday Neuroscience Seminars, something I had only seen more senior PhD students and group leaders do before. While I was somewhat nervous to present, it was a pleasure to come back to QBI and see old friends and colleagues again. I truly value the wonderful people I had the luck to be surrounded by during my time in Massimo's lab.

While I am loving the adventure of living and studying overseas, sometime in the future I would like to come back to Australia as it is a wonderful country. Who knows, maybe I'll even end up back at QBI.

QBI alumni

Dr Richard Moore
2008–2012

I FIRST DISCOVERED QBI when I learned that my future PhD supervisor, Professor Mandyam Srinivasan, had just moved his lab there from ANU in Canberra.

During an internship at CSIRO as part of my undergraduate studies, I attended a lecture presented by Professor Srinivasan on honeybees and how they use vision to achieve feats of navigation and how those same principles could inspire the design of guidance systems for autonomous aircraft. Even though it wasn't my field at the time, I remember being fascinated with his research so I got in contact and eventually made the move to Brisbane.

At QBI I worked with Professor Srinivasan to study how honeybees and other insects use vision to interpret their surrounding environment and their own motion through it. As an engineer, I was particularly interested in how those findings could be applied to the guidance of autonomous aircraft. For my PhD, I showed that by combining multiple bioinspired vision-based algorithms, difficult tasks such as landing autonomously or tracking a moving object could be performed by a small unmanned aircraft much more efficiently than by using traditional guidance techniques.

QBI was an exciting place to study and work because it is an internationally renowned institute and so there was a constant stream of world-leading scientists, researchers, and engineers giving seminars and visiting the lab. Fortnightly student BBQs on the QBI balcony—and the social atmosphere in general—were also really enjoyable.

I think the level of support that QBI provided to me as a student was essential for me to grow my research network internationally, setting up future collaborations and launching my career. I also really benefited from courses like the commercialisation workshops that encouraged you to think about applications of your work beyond your thesis.

After receiving my PhD I took up a postdoctoral fellowship at Harvard where I continued my work with bees—but this time robotic ones. The RoboBee project was a cross-disciplinary effort to push the boundaries of manufacturing, efficiency, and control, by producing a swarm of flapping-wing aerial robots the size of insects. I contributed a means for the RoboBee to navigate autonomously to and from the "hive" using a miniature vision system. In my current position with Valeo, I work with teams around the world to develop smart vision systems for enhancing the safety and autonomy of tomorrow's cars.

For decades we have been promised robots of all shapes and sizes that will take care of the jobs we don't want to do, but it is only relatively recently that robots have started becoming visible in everyday life—most noticeably in the form of self-driving cars and autonomous vacuum cleaners. By helping to invent safer and more efficient autonomous systems, I hope to see them benefit society in new and exciting ways, and perhaps one day to have my house cleaned by a swarm of robotic bees.

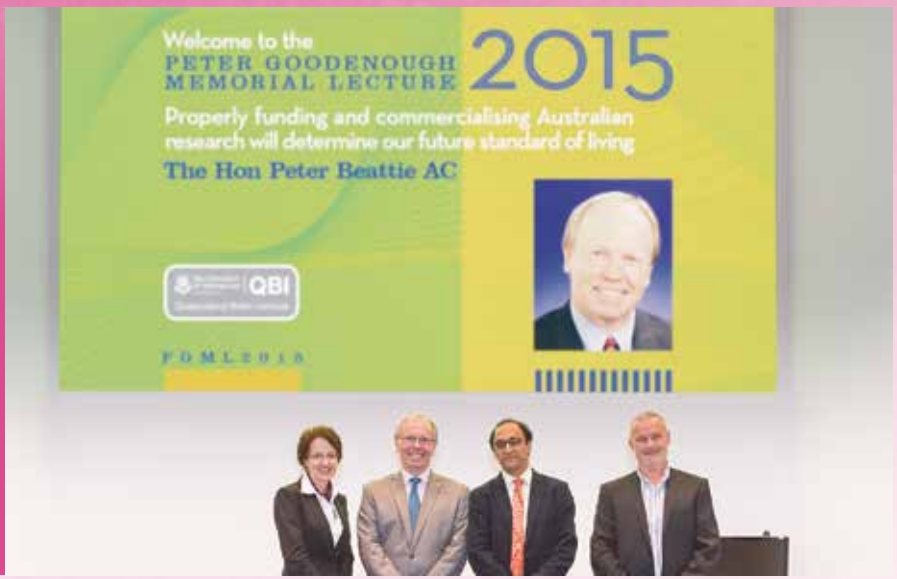
The 2015 Hand Heart Pocket Gala Evening, run by QBI and Alzheimer's Australia (Qld), raised money for Alzheimer's disease research and support services.

Community

Through world-class research, QBI is committed to improving the lives of individuals in the Australian and international communities.

To make neuroscience research accessible and understandable, in 2015 QBI researchers presented talks, guided tours and participated in community events.

Events



Peter Goodenough Memorial Lecture

Properly funding and commercialising Australian research will determine our future standard of living

THE 2015 PETER GOODENOUGH Memorial Lecture was delivered by The Hon Peter Beattie AC. On September 2, Mr Beattie shared his insights into how innovation and commercialisation of our world-class research will drive Australia's future economic growth.

He said it was the single most important challenge facing Australia's economy post-mining boom, as the traditional manufacturing industry continues to shrink and employment in the mining industry decreases.

Mr Beattie said Australia should be looking to the US, China and Germany, which recognised that 50 per cent of future jobs would be in the knowledge sector.

He said that the proper funding and commercialisation of Australia's world-class research would determine our future standard of living.

Peter Beattie AC was Premier of Queensland between 1998 and 2007, and for most of that time was also the Minister for Trade.

He is Director of the Medical Research Commercialisation Fund; ambassador for Life Sciences Queensland; a joint Adjunct Professor at The University of Queensland's Australian Institute for Bioengineering & Nanotechnology, and Institute for Molecular Bioscience; and a member of The University of Queensland's Industry Engagement Council.

He was awarded a Companion of the Order of Australia (AC) in 2012, and won the Biotechnology Industry Organisation's inaugural International Award for Leadership Excellence in 2008.

The Peter Goodenough Memorial Lecture is named in honour of Mr Peter Goodenough (1936–2004), a QBI benefactor, whose personal battle with motor neuron disease led to a bequest to fund fundamental scientific research.

QBI Breakfast Series

SINCE BEING INTRODUCED in 2013, the QBI Breakfast Series has continued to enable meaningful engagement with our donors, corporates and community groups in 2015.

Breakfasts in 2015:

Research in Autism Spectrum Disorder
SUPPORTED BY A CLEAR DIRECTION FINANCIAL PLANNING
Professor Linda Richards
Professor Elliott Sherr

Stroke: the latest in research, treatment and support
WITH STROKE QUEENSLAND
Dr Lavinia Codd
Libby Dunstan

MND: Ice Bucket Challenge
Professor Naomi Wray
Dr Shyuan Ngo
Nancy Frates

The Power of Attention
SUPPORTED BY MIND GARDENER
Professor Pankaj Sah
Professor Jason Mattingley and Ms Susan Pearse

CoralWatch
Professor Justin Marshall
Daniel Gschwind
(pictured above)

Hand Heart Pocket Gala Evening

QBI PARTNERED WITH Alzheimer's Australia (Qld) to create a lavish event to raise funds and awareness for Alzheimer's disease research and care.

The second annual Hand Heart Pocket Gala Evening on July 31 saw unforgettable performances in the Long Room of Brisbane's iconic Customs House, and a cocktail party overlooking the Brisbane River. Generously supported by Hand Heart Pocket, The Charity of Freemasons Queensland, and Morgans, the gala evening was attended by more than 200 guests who were dazzled by a night of opera and classical music.

The line-up was filled with opera singers who have had spectacular careers performing throughout concert halls in Europe and America. The world class artists featured on the night included soprano Natalie Peluso, mezzo soprano Mia Yaniw, tenor Jaewoo Kim, basso profundo David Hibbard, baritone Shaun Brown and the Aditaya String Quartet, led by musical director Norma Marschke.

Ita Buttrose AO OBE joined the performers in her role as National Ambassador for Alzheimer's Australia. She spoke about the importance of the work conducted by Alzheimer's Australia and QBI.

All funds raised went directly into Alzheimer's disease research at QBI, and the care and support services of Alzheimer's Australia (Qld).

Performers at the Hand Heart Pocket Gala Evening (L–R): Jaewoo Kim, Natalie Peluso, and Shaun Brown.

Australian Brain Bee Challenge

The Australian Brain Bee Challenge (ABBC) is QBI's public outreach program for high school students.

THE ABBC PROVIDES an opportunity to engage young Australians, as well as their families, teachers and the wider community, in learning about neuroscience and neuroscience research.

The ABBC has three rounds:

- round one, an online quiz, held in March during Brain Awareness Week, which tests students' knowledge and understanding of brain structure, function, anatomy, neurological disease and disorders
- round two, a State/Territory ABBC final where students are invited to attend a full day at a neuroscience research institute and become their State/Territory champion
- round three, a national final where each State/Territory representative competes to become the Australian Champion.

The Queensland ABBC is coordinated by QBI's Associate Professor Bruno Van Swinderen. Each year, round one attracts more than 1000 Year 10 Queensland students. Round two, the Queensland ABBC state final, took place at QBI on July 21 and was attended by 200 Year 10 students from 47 schools, as well as their teachers and parents. Many of the students travelled from regional areas to attend, including Biloela, Cairns, Ingham, Townsville, Rockhampton and Woree.

The program for the day aimed to excite young people about neuroscience and included tours of QBI's research laboratories and the opportunity to use QBI's Science of Learning Research Centre Empatica wristbands to monitor skin conductance activity, heart rate, movement, and body temperature response to the different activities on the day. Students and teachers also heard fantastic presentations from Associate Professor David Caldicott (Australian National University) and Associate Professor Paul Shaw (Washington University), as well as QBI PhD Student Project presentations by Alessandra Donato (Hilliard laboratory), Natalie Groves (Burne laboratory), Megan Campbell (Cunnington laboratory), Jing Zhao (Bartlett laboratory) and Ilvana Dzafic (Mowry laboratory).

After a close individual competition which finished with a sudden-death final, Somerville House student Abigail Green was the winner on the day, becoming the 2015 Queensland ABBC Champion. Associate Professor van Swinderen praised all of the students who participated in the 2015 ABBC for their competitive spirit and neuroscience knowledge. "Abigail can be really proud of her achievement in representing Queensland and joins the long line of tremendous state champions we have produced," he said. After the round two final, Abigail spent a week at QBI doing work experience in the Hilliard laboratory. "I've always loved science, which was why I did the challenge, and I found being involved in the ABBC really interesting," she said.

Australia's State and Territory ABBC finalists gathered at Sydney University and Western Sydney University on December 7 and 8 for the ABBC National Final. Abigail attended as the 2015 Queensland ABBC Champion and did extremely well, placing third.

QBI looks forward to hosting round two of the ABBC on July 19, 2016.

Above left: ABBC Queensland Champion Abigail Green and Associate Professor Bruno van Swinderen.

ABBC Queensland team winners from Kirwan State High School.

Philanthropy

RESEARCHERS AT QBI are dedicated to unlocking the mysteries of neurodegenerative diseases and mental health disorders, which currently account for a staggering 45 per cent of the burden of disease in Australia.

By improving the understanding of the fundamental mechanisms that regulate brain function, QBI researchers are working to develop new, more effective therapeutic treatments for conditions such as dementia, stroke, motor neuron disease, multiple sclerosis and neurotrauma.

QBI relies on both public and private donations to continue its research programs and is grateful for the support and generosity of its benefactors.

All members of QBI sincerely thank our valued donors for their support in 2015.

How to support QBI:

Donations

There are many ways in which you can help support QBI's research effort:

- Make a donation for a specific research area
- Purchase scientific equipment
- Fund scholarships for talented students
- Provide fellowships for early/mid-career researchers
- Sponsor Professorial Chairs
- Undertake laboratory dedications
- Provide gifts in memoriam
- Fundraise using the community fundraising platform Everyday Hero

Bequests

By leaving a bequest to QBI in your will, you are leaving a lasting legacy that accelerates current research and preserves future projects. Bequests can include:

- A percentage of an estate
- The residuary of an estate (what remains after all other gifts and costs have been deducted)
- A gift of a specific sum of money
- A specific asset, such as property, works of art, shares, or an insurance policy

Under current legislation, gifts to QBI are tax deductible.
To discuss how you can support the Institute, please contact us at:

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The University of Queensland
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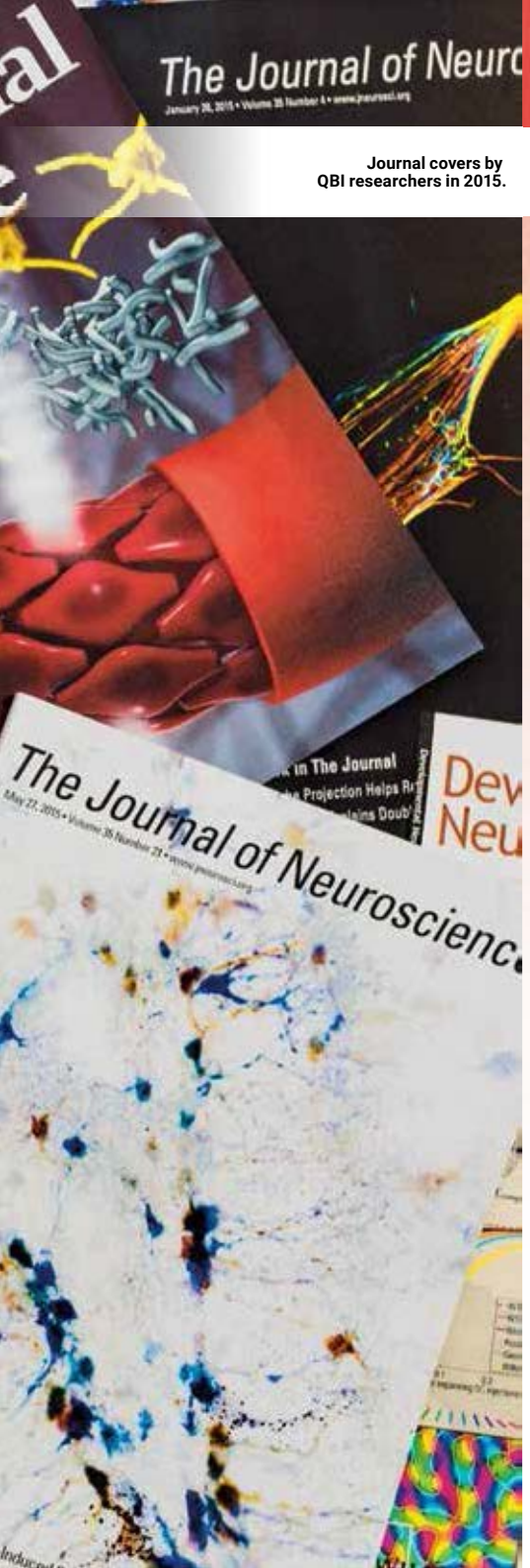

Journal covers by QBI researchers in 2015.

Publications

QBI representation on prestigious editorial boards, including the QBI-initiated journal *npj Science of Learning*, attests to the world-class calibre of our researchers.

The quality and number of scientific publications produced in 2015 stands QBI researchers in the top echelons of neuroscience research.

In 2015, QBI authors published 273 peer-reviewed papers, 21 of which were in *Nature* journals.

npj Science of Learning

In 2015, in collaboration with Nature Publishing Group, QBI launched an open-access Nature Partner Journal dedicated to the science of learning—*npj Science of Learning*.

THE PARTNERSHIP WAS initiated by QBI founding Director Professor Perry Bartlett and current Director Professor Pankaj Sah, and builds on the success of the Science of Learning Research Centre (SLRC), which is headquartered at The University of Queensland and involves several QBI staff.

Professor Sah, who directs the SLRC, will be Editor-in-Chief of the journal. In addition, QBI's Professor Stephen Williams and Professor Jason Mattingley will serve as Associate Editors for the journal. By partnering with Nature Publishing Group, QBI will work with a respected and prestigious brand in academic publishing.

The official launch of the journal took place at Customs House in April 2015, with a Science of Learning symposium held to coincide with the event. The symposium featured more than 20 speakers and panel members from across Australia and internationally, including the Program Director of the US Science of Learning Centers Dr Soo-Siang Lim; Dr Philip Campbell, Editor-in-Chief of *Nature*; and Professor Marian Simms, Executive Director for Social, Behavioural and Economic Sciences of the Australian Research Council. The symposium was attended by more than 100 researchers, educators and policy makers.

An outstanding international editorial board has been assembled and will help to ensure the journal's success. In collaboration with *Nature* staff, board members have engaged leading researchers from neuroscience, psychology and education at conferences in Australia and beyond, promoting the journal's mission and scope.

In creating this journal with Nature Publishing Group, QBI is positioning itself at the forefront of educational neuroscience. This is a relatively new research field that aims to integrate the findings of neuroscience, psychology and education to improve how we learn. The interdisciplinary approach here is key: understanding the science of learning needs to be complemented by practical implementation in classrooms, drawing on the expertise of educationalists and engaging both teachers and policy makers.

To reach this broad cross-section of the community, two steps have been taken. First, the journal is online and open-access, freely accessible to the public. Second, the highly technical research content within the journal will be accompanied by easy-to-understand summaries that are written for non-expert readers. Debate and information on learning and education are of huge interest to parents, teachers, politicians and policy makers, yet until now the research findings that drive improvement and reform have not been accessible—either physically or intellectually—to these parties. *npj Science of Learning* changes that.

In short, *npj Science of Learning* is an interdisciplinary and accessible journal that allows anybody to follow the latest research and discussion into the science of learning, and to appreciate the implications for education. This is an exciting venture for QBI, but ultimately it is the general public who has the most to gain through evidence-based improvements to education.

Above left (L–R): Editor-in-Chief, *Nature*: Dr Philip Campbell, Professor Perry Bartlett, Professor Pankaj Sah and Professor Peter Høj.

QBI publications

QBI researchers and **research higher degree students** (indicated in **bold**) contributed to the following publications, which were published for the first time in 2015, either online or in print.

Publications which were omitted from the 2014 Annual Report are also included.

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QBI publications

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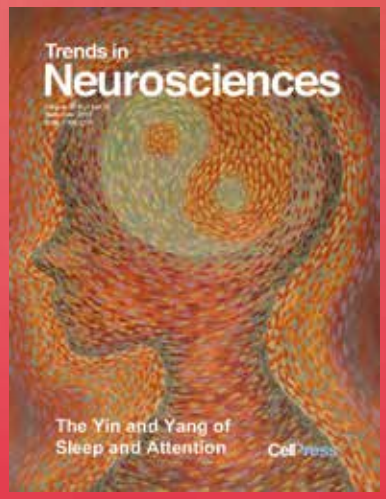

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Journal editorial boards

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- *Insights in Cell Science*, Editorial Board

Professsor Perry Bartlett

- *Acta Physiologica Sinica*, Editorial Board
- *Developmental Neurobiology*, Editorial Board
- *Frontiers in Neurogenesis*, Associate Editor
- *IBRO Reports*, Editorial Board
- *International Journal of Developmental Neuroscience*, International Editorial Board
- *Journal of Neuroscience Research*, Editorial Board
- *Neural Development*, Editorial Board
- *Neurosignals*, Editorial Board
- *Stem Cell Research*, Editorial Board
- *Yonsei Medical Journal*, Editorial Board

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- *Nature Partner Journal (npj) Science of Learning*, Associate Editor

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- *Nature Partner Journal (npj) Science of Learning*, Editor-in-Chief
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Professsor Stephen Williams

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- *Frontiers in Neural Circuits*, Associate Editor
- *Nature Partner Journal (npj) Science of Learning*, Editorial Board

Professsor Naomi Wray

- *Genetics*, Associate Editor
- *JAMA Psychiatry*, Associate Editor


RESEARCH
AUSTRALIA

QBI Founding Director Professor Perry Bartlett was honoured by Research Australia with a Lifetime Achievement award. Photo courtesy of Research Australia.

Recognition

QBI researchers are among the best in the world, as attested to by the quality of the fellowships, grants, and awards received in 2015.

Our staff also serve on professional committees and represent the Institute in a number of key scientific organisations.

Fellowships

National Health and Medical Research Council

Research Fellowships

Individual risk for conditions such as heart disease, diabetes, auto-immune disease and psychiatric disorders is a consequence of the accumulation of multiple genetic and environmental risk factors, which together determine disease susceptibility. During the course of his Senior Principal Research Fellowship, **Professor Peter Visscher** will develop novel data analysis methods to identify causative gene mutations and to predict disease risk and improve diagnosis. In particular, he will focus on brain-related complex traits, which have been implicated in psychiatric disorders, cognitive ageing and motor neuron disease.

Commencing in 2015, **Professor Naomi Wray** has been promoted to Principal Research Fellow. This will allow her to apply her expertise in genomics methods to drive discovery in the area of psychiatric disorders, ultimately leading to prevention strategies, improved diagnosis and more targeted treatments. Her goal is to increase our knowledge of genetic heterogeneity across diagnostic boundaries, thereby paving the way to explore genetic classifications with respect to drug treatment. She will also deliver a better understanding of the interplay between non-genetic and genetic risk factors for psychiatric disorders, and will assess the value of using genomic predictors in these conditions.

Professor Pankaj Sah

Professor Pankaj Sah, the recipient of a Principal Research Fellowship, has greatly increased our understanding of the neural circuits within a region of the brain known as the amygdala. Dysfunction in these circuits leads to a range of anxiety-related disorders, including post-traumatic stress. During his Fellowship, Professor Sah will investigate how information is encoded in the amygdala and how emotional memories are formed and retrieved. In collaboration with Brisbane neurologists he will also make recordings from humans, with the goal of developing targeted therapeutics.

Career Development Fellowships

Amyotrophic lateral sclerosis (ALS) is a progressive and terminal neurological disease which destroys the motor neurons that control muscle activity, such as walking and breathing. At present there is no diagnostic test for ALS and the current approved treatment only prolongs survival by three months, with most patients dying within three years. During the course of his Career Development Fellowship, **Dr Beben Benyamin** will apply his statistical, genetic, computational and bioinformatics expertise to dissect the genetic and epigenetic aetiologies of ALS, in order to discover novel genes and epigenetic marksers, and to determine their biological function. This knowledge will then be used in the search for an effective diagnosis, treatment and cure for the disease.

DNA methylation is an epigenetic mechanism that cells use to control experience-dependent gene expression, and there is increasing evidence that epigenetics plays a major role in the development of disease. The goal of **Dr Allan McRae's** Career Development Fellowship is to elucidate the genetic control of DNA methylation, in order to understand how this affects disease susceptibility, and to define the molecular processes underlying its effect on gene expression. This will elucidate the functional mechanisms driving many of the genetic associations for DNA methylation and gene expression levels, and provide valuable knowledge that can then be used to target them for future therapeutic interventions.

Early Career Fellowships

The fovea, the central part of the retina, is essential for everyday functions that require high acuity, such as reading or facial recognition. However, approximately one in seven Australians over the age of 50 suffers from some form of foveal blindness due to age-related macular degeneration (AMD). Although patients can use their intact peripheral retina to process visual information, peripheral vision is low-resolution and it is difficult to recognise objects in situations that involve visual clutter. The aim of **Dr Will Harrison's** Early Career Fellowship is to develop novel interventions that enhance the peripheral vision of AMD patients and to investigate the neural correlates of visual perception in peripheral vision. Ultimately, this work has the potential to inform rehabilitation strategies, such as the use of oculomotor training and adaptive displays.

Fellowships

Dr Jana Vukovic

Australian Research Council

Discovery Early Career Researcher Award

The major brain structure that is critical for learning and memory is the hippocampus, by its regulated production of new neurons throughout life (i.e. adult hippocampal neurogenesis). **Dr Jana Vukovic's** goal is to determine how these adult-born neurons exert their effects. Understanding these processes is critical, as deficits in learning and memory can lead to poor educational outcomes, reduced productivity and social isolation. Declines in cognitive performance can also occur as a result of normal ageing, which will be an increasing problem as the median age of the population increases. Dr Vukovic's research will provide new insights into the fundamental mechanisms that underpin optimal cognitive performance, as well as revealing potential cellular targets for therapeutic intervention to ameliorate or even reverse the processes underlying the development of learning and memory deficits. She now holds a joint appointment between the School of Biomedical Sciences and QBI.

Professor Linda Richards

Fellow of the Australian Academy of Science

In recognition of her contribution to neuroscience, **Professor Linda Richards** has been elected a Fellow of the Australian Academy of Science. This highly prestigious honour acknowledges Professor Richards' discoveries regarding the developmental mechanisms that regulate the formation of the corpus callosum, the largest fibre tract in the human brain. Her pioneering work has helped to establish the fundamental principles underlying how the corpus callosum forms in humans and animal models, and in particular the role of glial cells in this process. She has also discovered that balanced inputs to the two hemispheres are critical for the final stages of brain wiring development, information that has implications for our understanding of neural circuits.

Photo: Mark Graham.

Dr Divya Mehta

Brain & Behavior Research Foundation

NARSAD Young Investigator Grant

Dr Divya Mehta plans to establish a collaboration between researchers in Australia and the US to perform genome-wide genetic profiling of 300 samples to identify early predictive biomarkers for postpartum depression. The study is designed to confirm results of a pilot study demonstrating that gene expression profiles in blood samples from the third trimester of pregnancy could predict postpartum depression with 88 percent accuracy.

Fellowships

Dr Shyuan Ngo

Scott Sullivan Research Fellow

Over the last four years, **Dr Shyuan Ngo's** research has focussed on trying to understand how changes in the way the body and nerve cells use energy can affect how quickly motor neuron disease (MND) progresses. As the Scott Sullivan Fellow, Dr Ngo has continued with this research in 2015, working alongside a team of dedicated clinicians and scientists who are all striving for a world free of MND.

Dr Ngo's research is pioneering treatment strategies for MND. In mouse models of MND, she has shown that the death of nerve cells occurs alongside changes in the way the whole body and cells use energy. By pharmacologically enhancing the way that energy is used, her work has been able to improve the motor symptoms that are associated with neuronal death in these mice.

Working alongside MND patients, Dr Ngo and her team have shown that changes in whole body energy use also occur as they progress through disease. Together they have made a number of critical observations that suggest that MND patients are not using energy efficiently, and this may in turn affect how they are able to cope with MND. These findings have led to the birth of a number of new projects that are trying to pinpoint the cause of the problem in energy use in patients.

Dr Ngo's ongoing research aims to repurpose FDA-approved compounds that target energy pathways with the goal of saving neurons in mouse models of MND, and to show that these compounds can also protect neurons—derived from induced pluripotent stem cells of MND patients—from dying.

Ross Maclean Fellowship

With the support of the Ross Maclean Fellowship, **Dr Marie Mangelsdorf's** work focussed on uncovering the genetic causes of motor neuron disease (MND).

Work at QBI aims to understand how misfunctioning RNA processing leads to motor neuron cell death; to date around one quarter of the known MND genes are known to be involved in this process.

Work supported by the Ross Maclean Fellowship forms part of a large multifaceted collaborative project that is using next-generation sequencing to find novel MND genes, led by **Professor Naomi Wray** and **Professor Peter Visscher**, who are world leaders in genomics. This work involves sequencing the genomes of MND patients, collecting data from large cohorts in China and Holland.

S.A.L.S.A. Systems Genomics Consortium

Professor Wray is also co-ordinating Australia's largest study into sporadic cases of MND, which account for 10% of cases. The Sporadic ALS Australian Systems Genomics Consortium (SALSA-SGC) involves sixteen researchers from nine MND centres across Australia as well as international collaborators. They are working together to build an integrated infrastructure for the collection and analysis of biological samples and clinical data. This pooled expertise will lead to a better understanding of the causes of sporadic MND.

Fellow of the Queensland Academy of Arts and Sciences

QBI Director **Professor Pankaj Sah** was admitted as a Fellow of the Queensland Academy of Arts and Sciences in 2015 for his significant contributions to neuroscience and his leadership of research into the science of learning. The Queensland Academy of Arts and Sciences aims to "promote advances in the arts and sciences, and to give a voice to scholars, thinkers, and social commentators from a wide range of disciplines".

Fellow of the Australian Academy of Health and Medical Sciences

In 2015 **Professor John McGrath** was elected as a Fellow of the newly formed Australian Academy of Health and Medical Sciences. Professor McGrath. One of only two recipients of an NHMRC John Cade Fellowship for Mental Health Research, he was honoured for his innovative research program that has linked epidemiology with experimental neurobiology to identify non-genetic risk factors for schizophrenia such as developmental vitamin D deficiency and paternal age. He has also made a major contribution to the discipline as Executive Director of the Queensland Centre for Mental Health Research and a member of the NHMRC Research Committee and the Australian Health Ethics Committee.

Awards

Professor Perry Bartlett

CSL Florey Medal

Professor Perry Bartlett is the recipient of the 2015 CSL Florey Medal, which is awarded biennially to an Australian researcher for a significant contribution to biomedical science and/or human health. Professor Bartlett was honoured for his pioneering work in the discovery of neural stem cells in the adult brain, and his career-long leadership in the discipline. His seminal studies underpin many current efforts to harness the potential of neural stem cell populations in ameliorating neurological diseases such as dementia, and mental health disorders such as depression.

Photograph: Lorna Sim.

Research Australia Lifetime Achievement Award

In another accolade acknowledging his career-long commitment to supporting and promoting health and medical research, **Professor Perry Bartlett** also received the 2015 Research Australia Lifetime Achievement Award. Professor Bartlett has been a dedicated advocate for Australian neuroscience, and has made a significant contribution to the growth of national research capacity through the establishment of the Queensland Brain Institute. His individual research excellence is also exemplary, as is his advocacy for the critical importance of basic scientific discoveries in driving clinical and biotechnological advances.

Australian Academy of Science

Ruth Stephens Gani Medal

Associate Professor Jian Yang was awarded the 2015 Ruth Stephens Gani Medal for his contributions to solving the "missing heritability" paradox through the development and application of novel statistical genetics methods that have allowed him to quantify the contribution of common genetic polymorphisms to trait variation. The ultimate goal of this work is to identify genes, functional elements, or pathways that play a major role in complex diseases, particularly mental disorders.

PROSE Award

Professor Justin Marshall has been acknowledged in the 2015 PROSE Awards for the success of his co-authored book *Visual Ecology*, which won the prize for best textbook in the biological and life sciences. The goal of these American Publishers Awards for Professional and Scholarly Excellence is to recognise publishers and authors for "their commitment to pioneering works of research and for contributing to the conception, production and design of landmark works in their field".

Federation of Asian and Oceanian Biochemists and Molecular Biologists

Young Scientist Award

As the recipient of the 2015 Federation of Asian and Oceanian Biochemists and Molecular Biologists (FAOBMB) Young Scientist Award, **Dr Victor Anggono** was able to present his work at the 14th FAOBMB Congress in Hyderabad, India, and to take part in its Young Scientist Program. Dr Anggono's research focusses on AMPA receptors, which mediate the majority of fast excitatory synaptic transmission in the mammalian central nervous system. Discovering how these receptors are regulated is critical for understanding nervous system function, given that dynamic changes in synaptic strength are thought to underlie critical processes such as information coding and storage during learning and memory.

Australian Society of Medical Research

Queensland Health and Medical Research Senior Researcher Award

Dr Shyuan Ngo, who holds a joint appointment between the School of Biomedical Sciences and QBI, was the recipient of the 2015 Australian Society of Medical Research Queensland Health and Medical Research Senior Researcher Award.

Grants

We are grateful for the following national and international grants and fellowships starting in 2015; GST and yearly increments are not included in the amounts shown. Grants and fellowships awarded by The University of Queensland have also been included. **QBI researchers** are denoted in **bold**.

Alzheimer's Australia Dementia Research Foundation

Research Grants

Anggono, Victor - Ubiquitinomic profiling of synaptic proteins in Alzheimer's disease, 12/02/2015–31/01/2016, $50000.

Australian Cancer Research Foundation grants

Reutens, David; Cooper, Matthew; Smith, Maree; Boyd, Andrew; **Richards, Linda**; **Bartlett, Perry**; Russell, Pamela; Walker, David; Bhalla, Rajiv; Barth, Markus; Palmieri, Chiara; Thurecht, Kristofer; Venkatachalam, Taracad; Allavena, Rachel; Straw, Rodney; Tesiram, Yasvir; **Bunt, Jens**; Francois, Mathias; **Osborne, Geoffrey** - ACRF Facility for Molecular Imaging Agents in Cancer, (awarded to and administered by UQ's Centre for Advanced Imaging) 5/7/2015–4/7/2022, $2500000.

Australian Government Cooperative Research Centres (CRC) Program

CRC for Living with Autism Spectrum Disorders (Autism CRC Limited)

CRC Program 1 Project grants

Gratten, Jake; **Wray, Naomi** - Development and validation of systems genomics-based predictors for autism (Stage 1), 7/12/2015–7/06/2018, $1743245.

Australian Research Council

Discovery Early Career Researcher Awards

Powell, Joseph - Novel approaches for understanding how genetic variation regulates the transcriptome (awarded to UQ's Diamantina Institute, transferred to QBI in 2015, now administered by UQ's Institute for Molecular Bioscience), 1/01/2013–31/12/2015, $364525.

Vukovic, Jana - How does neurogenesis in the adult hippocampus influence learning & memory? (awarded to QBI but transferred to UQ's School of Biomedical Sciences), 1/01/2015–31/12/2017, $372000.

Discovery Project Grants

Cheney, Karen; **Marshall, Justin**; Endler, John - How different is different: highly contrasting colours in animal patterns (awarded to and administered by UQ's School of Biological Sciences), 17/02/2015–16/02/2018, $497800.

Goodhill, Geoffrey - The plasticity of neural codes, 1/01/2015–31/12/2017, $439000.

Lynch, Joseph - The role of zinc in synaptic transmission in the central nervous system, 1/01/2015–31/12/2017, $369900.

Meunier, Frederic - Unravelling the mechanism of vesicular docking in neurosecretory cells, 1/01/2015–31/12/2018, $434500.

BioPharmaceutical Australia

Biopharmaceutical Development Fund

Bartlett, Perry - A novel ephrinA4-Fc fusion protein for the treatment of neurodegenerative disease, 1/01/2015–31/12/2016, $250000.

Brain and Behavior Research Foundation

NARSAD Young Investigator Awards

Mehta, Divya - Early predictive biomarkers for postpartum depression, 15/01/2015–14/01/2017, $41047 for 2015.

Brain Foundation

Research Gifts

Bunt, Jens; **Richards, Linda** - Can (re-)activating the NFI pathway be used to treat primary human GBM tumours? 1/01/2015–31/12/2015, $39842.

Contributing to Australian Scholarship and Science Travel Awards

Suárez, Rodrigo - The role of neural activity in early postnatal wiring of interhemispheric cortical circuits, 18/05/2015–20/05/2015, $2500.

Hydrocephalus Association

Innovator Award Research Grants

Piper, Michael - Analysis of the role of NFIX in the development of hydrocephalus, (awarded to and administered by UQ's School of Biomedical Sciences), 1/12/2015–30/11/2016, $30484.

Ian Potter Foundation

Travel Grants

Zhao, Qiongyi - Ian Potter Foundation Travel Grant to attend Keystone Symposium meeting on Neuroepigenetics, Santa Fe, Mexico, 21/2/2015–26/02/2015, $2000.

International Brain Research Organisation

International Travel Grants Funding Program

Suárez, Rodrigo - Development and evolution of interhemispheric cortical connections, 1/01/2015–31/12/2015, $3000.

The MND and ME Foundation and Metro North Hospital and Health Service

Ngo, Shyuan - The Scott Sullivan Research Fellowship, Fellow appointed 31/01/2015–31/12/2017, $194999.

Motor Accident Insurance Commission

Nasrallah, Fatma - Motor Accident Insurance Commission QBI Senior Research Fellowship, Fellow appointed 31/10/2015–31/10/2020, $1500000.

Motor Neurone Disease Research Institute of Australia Inc.

Ice Bucket Challenge Grant

Wray, Naomi; Blair, Ian; **Benyamin, Beben**; Henderson, Robert; Kiernan, Matthew; Laing, Nigel; Mathers, Susan; McCombe, Pamela; Nicholson, Garth; Pamphlett, Roger; Rowe, Dominic; Schultz, David; **Visscher, Peter**; Vucic, Steve; Williams, Kelly; **Zhao, Qiongyi**. - Sporadic ALS Australian Systems Genomics Consortium (SALSA-SGC), 6/10/2015–30/11/2018, $1050000.

Grants

National Health and Medical Research Council

Career Development Fellowships

Benyamin, Beben - An integrated genomic and epigenomic approach to dissect the aetiology of motor neuron disease, 1/01/2015–31/12/2018, $411768.

McRae, Allan - Genetics of DNA methylation and its role in disease susceptibility, 1/01/2015–31/12/2018, $411768.

Early Career Fellowships

Harrison, William - Novel approaches to understanding peripheral vision in patients with central vision loss, 1/06/2015–31/05/2019, $289436.

Power, Robert – Understanding the genetic architecture of psychiatric disorders in patients and populations (Declined).

Project Grants

Benyamin, Beben; **Brion, Marie-Jo** - Novel epidemiological methods to infer the causal effects of risk factors on neuropsychiatric and cardiovascular disorders, 1/01/2015–31/12/2017, $358957.

Burne, Thomas; **McGrath John** - Does adult vitamin D deficiency increase vulnerability to social stress resulting in altered brain function? 1/01/2015–31/12/2017, $319776.

Cunnington, Ross; Windischeberger, Christian; Barth, Markus - High-resolution brain imaging of basal ganglia function, 1/01/2015–31/12/2017, $570364.

Evans, David; Relton, Caroline; **Powell, Joseph**; Smith, George - Novel ways of utilizing genome-wide DNA methylation data from peripheral blood samples in genetic epidemiology (awarded to and administered by UQ's Diamantina Institute), 1/01/2015–31/12/2017, $276398.

Evans, David; Venkatesh, Bala; **Powell, Joseph**; Myburgh, John; Finfer, Simon; Cohen, Jeremy; McLachlan, Geoffrey - Gene expression profiling in critically ill patients with septic shock: The ADRENAL-GEPS Study (awarded to and administered by UQ's Diamantina Institute), 1/01/2015–31/12/2017, $834270.

Fath, Thomas; **Anggono, Victor**; Gunning, Peter; Power, John; Karl, Tim; Masedunskas, Andrius - Targeting the synaptic actin cytoskeleton in Alzheimer's Disease (awarded to and administered by the University of New South Wales), 1/01/2015–31/12/2018, $808872.

Goodhill, Geoffrey - Computational analysis of the influence of growth cone shape dynamics on axon guidance, 1/01/2015–31/12/2017, $335492.

Hannan, Anthony; **Bredy, Tim**; Pang, Terrance - Transgenerational impacts of paternal stress on offspring mental health: Epigenetic mechanisms and therapeutic interventions (awarded to and administered by the University of Melbourne), 1/01/2015–31/12/2017, $554937.

Laird, Angela; Nicholson, Garth; Becker, Thomas; **Giacomotto, Jean** - Investigating drug treatments for a Machado Joseph disease using transgenic zebrafish (awarded to and administered by the University of Sydney), 1/01/2014–31/12/2016, $428834.

Lee, Sang Hong; **Gerhard, Moser**; **Yang, Jian** - Advanced whole-genome approaches for causative variant detection and individual risk prediction of complex traits in human populations (awarded to QBI but transferred to University of New England in 2015), 1/01/2015–31/12/2017, $343952.

Lynch, Joe; **Keramidas, Angelo** - Using artificial synapses to investigate the functional pathology underlying epilepsy, 1/01/2015–31/12/2017, $498009.

Martin, Nicholas; **Wray, Naomi**; Hickie, Ian; Licinio, Julio; **Byrne, Enda**; Medland, Sarah - Tackling heterogeneity in the etiology of major depressive disorder (awarded to and administered by The Council of the Queensland Institute of Medical Research), 1/01/2015–31/12/2019, $2445015.

Powell, Joseph - Determining shared genetic control of RNA transcription across 45 human tissue types (awarded to QBI but transferred to UQ's Institute for Molecular Bioscience), 1/01/2015–31/12/2017, $256398.

Sale, Martin; **Mattingley, Jason**; Giulio, Tononi - Mimicking slow wave sleep to enhance plasticity in the elderly human brain, 1/03/2015–28/02/2018, $415106.

Wen, Wei (from Jan 2015); Sachev, Perminder (2013-2014); **Wright, Margaret** (The Council of the Queensland Institute of Medical Research, now at QBI from 28/10/2015); Ames, David; Baune, Bernhard; Lee, Teressa; Crawford, John - The Older Australian Twins Study (OATS) of healthy brain ageing and age-related neurocognitive disorders (awarded to and administered by the University of New South Wales from 2013), 1/1/2013–31/12/2015, $1045325.

Williams, Stephen - Role of dendritic information processing in visual circuit computations, 1/01/2015–31/12/2018, $861300.

Wray, Naomi; Blair, Ian - Gene discovery in motor neuron disease through systems genomics, 1/01/2015–31/12/2017, $918784.

Wray, Naomi; **Lee, Sang Hong**; **Gratten, Jacob** - Multivariate whole genome estimation and prediction analysis of genomics data applied to psychiatric disorders, 1/01/2015–31/12/2019, $610529.

Wright, Margaret; de Zubicaray, Greig; McMahon, Katie; Thompson, Paul - Neurodevelopment during adolescence: a longitudinal imaging study (awarded to The Council of the Queensland Institute of Medical Research but transferred to QBI in 2015), 1/01/2015–31/12/2020, $1634767.

Research Fellowships

Sah, Pankaj - Principal Research Fellowship: Neural circuits that underpin fear and anxiety, 1/01/2015–31/12/2019, $739980.

Visscher, Peter - Senior Principal Research Fellowship: Neurogenetics and statistical genomics, 1/01/2015–31/12/2019, $886915.

Wray, Naomi - Principal Research Fellowship: Using genomics to understand psychiatric disorders, 1/01/2015–31/12/2019, $739980.

Grants

National Institutes of Health (USA)

Research Program Project Grants (R01)

Eyles, Darryl (Gayle Wynham, US lead, Sequoia Foundation, 2015-2018) - Role of pre-natal Vitamin D and gene interactions in Autism Spectrum Disorders; leveraging an existing case-control study, $76126 for 2015.

Richards, Linda (Elliot Sherr, US Lead, University of California, 2007–2020) - ACC: callosal agenesis as a window into common neurodevelopmental disorders, no funding requested for 2015.

Van Swinderen, Bruno (Paul Shaw, US Lead, Washington University, 2011–2016) - Functional analysis of sleep promoting neurons in health and disease, $132024 for 2015.

Visscher, Peter (Matthew Keller, US Lead, University of California, 2013–2017) - Estimating the frequencies and population specificities of risk alleles, $153322 for 2015.

Wray, Naomi Visscher, Peter; **Powell, Joseph** (Patrick Sullivan, US Lead, University of North Carolina Chapel Hill, 2006–2019) - 1/2 A Large-Scale Schizophrenia Association Study in Sweden, $132038 for 2015.

Exploratory/Developmental Research Grant Awards (R21)

Eyles, Darryl; **McGrath, John** (Brian Lee, US lead, Drexel University, 2014-2016) - Early life vitamin D levels and risk of autism spectrum disorders, 2015 funding: $72339.

Visscher, Peter (Isaac Kohane, US lead, Harvard Medical School, 2015-2017) - Increasing the power of GxE detection by using multi-locus genome-wide predictors, $70668 for 2015.

Research Program Project Grants (P01)

Visscher, Peter (Bruce Weir, US lead, University of Washington, 2012–2017) - Statistical and Quantitative Genetics, $202006 for 2015.

Cooperative Agreements (U54)

Wright, Margaret (Paul Thompson, US lead, University of Southern California, 2014–2018) - ENIGMA Center for Worldwide Medicine, Imaging & Genomics, $63025 for 2015.

Rebecca L. Cooper Medical Research Foundation

Research Grants

Burne, Thomas - Reverse translation of cognitive tasks for animal models of neuropsychiatric disorders, 24/01/2015–31/12/2015, $138000.

Suárez, Rodrigo; **Richards, Linda** - The role of neural activity in early postnatal wiring of interhemispheric cortical circuits, 1/03/2015–31/12/2015, $22000.

Society of Biological Psychiatry

International Travel Awards

Mehta, Divya - International Travel Award, 1/01/2015–31/12/2015, $2000.

Stafford Fox Medical Research Foundation

Zuryn, Steven - The Stafford Fox Medical Research Foundation for a Senior Research Fellowship in Stroke-Induced Dementia, Fellow appointed 1/09/2014–1/09/2019, $2500000.

The Wesley-St. Andrew's Research Institute Limited

Walker, David; **Osborne, Geoffrey** - Searching for novel prognostic indicators of survival for glioblastoma patients (awarded to and administered by the Wesley Research Institute), 2/03/2015–28/02/2016, $18834.

The University of Queensland

Advancing Women Researchers Grants

Vinkhuyzen, Anna - UQ Advancing Women Researchers Grants 2015 Round - World Congress of Psychiatric Genetics, 18/05/2015–5/08/2016, $1867.

Early Career Researcher Grants

Mehta, Divya - To investigate the biological mechanism underlying the long-term beneficial effects of pregnancy for Multiple Sclerosis, 1/01/2015–22/07/2016, $40000.

Major Equipment and Infrastructure Grants

Cooper, Helen; **Götz, Jürgen**; **Richards, Linda**; **Piper, Michael**; **Goodhill, Geoffrey**; **Hilliard, Massimo** - Spectral applied research spinning disc confocal microscope for high speed 3D imaging of tissue and live organisms, 1/01/2015–31/12/2015, $236195.

Boyd, Roslyn; Liley, Helen; Hurrion, Elizabeth; Rose, Stephen; Wallace, Geoffrey; Dawson, Paul; Colditz, Paul; **Richards, Linda**; Jardine, Luke; Gray, Peter; Justo, Robert; Corness, Jonathon - Optimising Neonatal Neuroplasticity: research consortium for an MRI compatible incubator at Lady Cilento Childrens Hospital and the Mater Mothers Hospital at the University of Queensland, 1/1/15–31/12/2015, $210000.

UQ-NHMRC Equipment Grants

Perry Bartlett; **Sah, Pankaj**; **Götz, Jürgen**; **Richards, Linda**; **Cooper, Helen**; **Piper, Michael**; **Coulson, Elizabeth**; **Bredy, Timothy**; **Hilliard, Massimo**; **Meunier, Frederic**; **Marshall, Justin**; **Blackmore, Daniel** - Computerised stereotaxic stages and rapid tissue processor for enhanced fixation and immunolabelling, 1/01/2015–31/12/2015, $80196.

Postdoctoral Research Fellowships

Durisic, Nela - The effects of human epilepsy mutations on synaptic GABA-A receptors studied by localization-based Super-resolution microscopy, 1/01/2015–31/12/2017, $346409.

Padmanabhan, Pranesh - Mathematical modelling of neural wiring development, 1/01/2015–31/12/2017, $324298.

Travel Awards for International Collaborative Research

Porter, Megan (visiting academic), **Marshall, Justin**, 1/01/2015–31/12/2015, reimbursement of travel expenses.

Vice-Chancellor's Research Focused Fellowships

Hilliard, Massimo - Axonal fusion: new strategies to repair injured axons (Relinquished to take up an NHMRC Senior Research Fellowship in 2016).

Commercial development

3D-printed imitation bone is being used by QBI scientists at the Clem Jones Centre for Ageing Dementia Research to simulate how sound waves travel through bone.

QBI HAD A successful year in progressing the translation of its research under the direction of Professor Perry Bartlett and, subsequently, Professor Pankaj Sah.

QBI has focused its attention on growing its industry engagement and will continue to develop and protect its intellectual property. QBI has been able to recruit and maintain a team of internationally recognised research staff and leading technologies, which has allowed the Institute to position itself as a leader in neuroscience research in the Asia-Pacific region. QBI also has the people and processes to identify new commercial opportunities with the support of UniQuest, the main commercialisation arm of The University of Queensland.

In particular QBI has made significant progress towards the commercialisation of two key projects in 2015, one in the therapeutic field and one in the medical device field. For the first, under the direction of Professor Bartlett and Professor Andrew Boyd, QBI has been working on a therapeutic targeting EphA4 that is progressing towards a clinical trial.

As well as securing grant funding to support some of these activities through the competitive Biopharmaceuticals Australia (BPA) scheme, a potential licensing deal is being discussed with a company who would then fund the preclinical and initial clinical development.

In the second project, QBI's Professor Jürgen Götz, from the Clem Jones Centre for Ageing Dementia Research, has continued to work on the recent discovery of non-invasive ultrasound technology as a potential treatment for Alzheimer's disease. The technology has been shown to be effective in mouse models as measured by improved memory function. Professor Götz's team is working towards developing a medical device prototype for testing in larger animals before potentially commencing human trials.

QBI also continued to work with a number of industry partners in 2015, including Boeing Defence Australia, and several QBI researchers will participate in the Cooperative Research Centre (CRC) for Living with Autism Spectrum Disorders and the Science of Learning Centre funded by the Australian Research Council. QBI researchers continue to work with Euclideon, a Brisbane-based 3D visualisation company, to build new 3D visualisation tools to support brain research. QBI has also partnered with Nature Publishing Group to establish the journal *npj Science of Learning* with Professor Pankaj Sah as Editor-in-Chief, which is a prestigious accomplishment for the Institute.

QBI has also made several invention disclosures this year, and will work with UniQuest to develop translational strategies for these discoveries. Of note is a discovery from the Götz lab relating to tau-specific antibodies, which may have significant implications as a potential therapeutic to battle some of the causes of Alzheimer's disease. A discovery from the Hilliard lab in axonal fusion was important and could have significant implications in neurosurgery and for patients with nerve and spinal cord injuries. Finally, a discovery from the Meunier lab regarding free fatty acids generated during neuronal communication might be important for our understanding of memory—and could potentially affect not only those suffering with aging dementia but the wider community.

In 2016 QBI will work to provide more guidance and support to QBI researchers to assist in translating their research, through forums and with the ongoing support of UniQuest. UniQuest will continue to work alongside the Institute's research teams to pursue commercial opportunities arising from their research. To further support this, UniQuest will be delivering educational support to QBI's postgraduate and early-career researchers about how they can use industry engagement and technology transfer to enhance the commercial potential of their research. One way this will also be achieved is through QBI participation in UniQuest's annual commercialisation workshop, which provides UQ researchers with the opportunity to receive expert advice and guidance from professionals working in the pharmaceutical, biotechnology, investment, intellectual property and research commercialisation sectors.

Also in 2015, QBI had one of the first products from UQ available for direct sale via online transactions on UniQuest's recently launched eShop. The product called Dicer is software developed at QBI for flow cytometry machines enabling those machines around the world to sort specifically for infrequent cell types (http://eshop.uniquest.com.au/dicer/).

QBI also attended and exhibited at BIO2015 in Philadelphia. BIO is one of the largest international conferences for biotechnology and QBI and UniQuest held several discussions with pharmaceutical and biotechnology companies around research and commercial opportunities. QBI also exhibited as part of the Life Science Queensland delegation at BIO2015 and looks forward to attending BIO2016 in San Francisco.

Neuroscience seminars

Through a weekly seminar program, QBI gives neuroscientists an opportunity to learn more about the latest scientific developments. The series challenges researchers in their thinking, promotes excellence through the exchange of ideas and leads to future collaborations. Speakers in the 2015 QBI Neuroscience Seminar Series are listed below in alphabetical order.

Joon-Yong An
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Identification and functional characterization of genetic variants in an Australian autism spectrum disorder cohort

Dr Victor Anggono
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Molecular mechanisms of AMPA receptor trafficking

Dr Maria Elena Avale
INSTITUTE OF MOLECULAR BIOLOGY AND GENETIC ENGINEERING (INGEBI), ARGENTINA
Modulating tau isoforms by RNA reprogramming: functional consequences and therapeutic perspectives

Danay Baker-Andresen
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
DNA methylation: an epigenetic watermark of cocaine self-administration

Dr Rosemary Bagot
ICAHN SCHOOL OF MEDICINE AT MOUNT SINAI, USA
Glutamatergic circuits in stress susceptibility: pathway specificity and transcriptional mechanisms

Stephanie Biergans
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
DNA methylation and its role in honey bee memory formation

Dr Paola Bossù
IRCCS SANTA LUCIA FOUNDATION, ROME, ITALY
Peripheral immune modifications in Alzheimer's disease: a focus on myeloid dendritic cells

Assistant Professor Adam Claridge-Chang
INSTITUTE OF MOLECULAR AND CELL BIOLOGY, DUKE-NUS MEDICAL SCHOOL, SINGAPORE
The superior serotonergic neurons promote tranquillity in Drosophila

Professor Colin Clifford
SCHOOL OF PSYCHOLOGY, UNSW, SYDNEY
Vision in an uncertain world: Processing of contour orientation in human primary visual cortex

Associate Professor Helen Cooper
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Understanding the developmental origins of cortical malformations

Aymeric Denuelle
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Bio-inspired visual homing strategies for autonomous aerial navigation

Daina Dickens
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Is brain plasticity altered in motor regions of healthy older adults?

Professor Karl Friston
WELLCOME TRUST CENTRE FOR NEUROIMAGING, UNIVERSITY COLLEGE LONDON, UK
I am therefore I think

Professor Geoffrey Goodhill
QUEENSLAND BRAIN INSTITUTE AND SCHOOL OF MATHEMATICS AND PHYSICS, THE UNIVERSITY OF QUEENSLAND
A computational perspective on the brain

Professor Kirsten Harvey
UCL SCHOOL OF PHARMACY, UNIVERSITY COLLEGE LONDON, UK
Wnt signalling mediated cellular and molecular mechanisms in the pathogenesis of Parkinson's disease

Professor Volker Haucke
DEPARTMENT OF MOLECULAR PHARMACOLOGY AND CELL BIOLOGY, FREIE UNIVERSITAT, BERLIN
Where the tortoise and the hare meet: clathrin and adaptors in synaptic vesicle cycling

Nick Hughes
QUEENSLAND BRAIN INSTITUTE AND SCHOOL OF MATHEMATICS AND PHYSICS, THE UNIVERSITY OF QUEENSLAND
Neural plasticity via visual cortical maps

Professor Craig P Hunter
DEPARTMENT OF MOLECULAR AND CELLULAR BIOLOGY, HARVARD UNIVERSITY, CAMBRIDGE, USA
Mobile RNA and trans-generational epigenetic inheritance: mechanisms, functions, and prevalence

Professor Carlos Ibanez
NATIONAL UNIVERSITY OF SINGAPORE
Mechanisms of diversification and allocation of cortical GABAergic interneurons

Oscar Jacoby
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Do attention and working memory use the same executive control resources?

Professor Tianzi Jiang
QUEENSLAND BRAIN INSTITUTE AND CENTRE FOR ADVANCED IMAGING, THE UNIVERSITY OF QUEENSLAND
THE BRAINNETOME CENTER, INSTITUTE OF AUTOMATION, CHINESE ACADEMY OF SCIENCES, BEIJING, CHINA
Brainnetome atlas: a new brain atlas based on connectivity profiles

Leonie Kirszenblat
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
The yin and yang of sleep and attention

Associate Professor Arun Krishnan
TRANSLATIONAL NEUROSCIENCE FACILITY, SCHOOL OF MEDICAL SCIENCES, UNIVERSITY OF NEW SOUTH WALES
Diabetes and the nervous system: the journey from animal models to neuroprotective treatments

Professor Nigel Laing AO
NEUROGENETIC DISEASES LABORATORY, HARRY PERKINS INSTITUTE OF MEDICAL RESEARCH, THE UNIVERSITY OF WESTERN AUSTRALIA
Neurological disorders: finding the causes, accurate diagnosis and prevention

Professor Chris Levi
DIRECTOR OF CLINICAL RESEARCH AND TRANSLATION, RESEARCH, INNOVATION AND PARTNERSHIPS, HUNTER NEW ENGLAND LOCAL HEALTH DISTRICT, JOHN HUNTER HOSPITAL, NSW
Update on the treatment of ischaemic stroke

Xiang Li
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Tet-mediated DNA hydroxymethylation within the prefrontal cortex as a mechanism for the formation and maintenance of fear-related memory

Professor Manfred Lindau
CORNELL UNIVERSITY, ITHACA, USA
The nanomechanical mechanism of exocytotic fusion pore formation

Dr Y-Peng Loh
NATIONAL INSTITUTE OF CHILD HEALTH DEVELOPMENT, BETHESDA, USA
Neurotrophic factor α-1: a key regulator of neuroprotection and depression during stress

Professor Justin Marshall
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
400 million year old colour and polarisation vision: New developments in bio-inspired imaging and information flow from the sea

Professor Carol Mason
COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY, USA
The path from eye to brain: Genes encoding neurogenesis and wiring in the binocular circuit

Professor Steve McCarroll
DEPARTMENT OF GENETICS, HARVARD MEDICAL SCHOOL, BOSTON, USA
Cells, genes, and molecular mechanisms

Dr Rodrigo Medeiros
INSTITUTE FOR MEMORY IMPAIRMENTS AND NEUROLOGICAL DISORDERS, UNIVERSITY OF CALIFORNIA
Inflammatory resolution in Alzheimer's disease

Neuroscience seminars

Dr Sarah Medland
QIMR BERGHOFER MEDICAL RESEARCH INSTITUTE
Using collaboration to advance our understanding of brain structure: Results from the ENIGMA consortium

Professor Read Montague
DEPT OF PHYSICS & VIRGINIA TECH CARILION RESEARCH INSTITUTE, VIRGINIA TECH
THE WELLCOME TRUST CENTRE FOR NEUROIMAGING, UNIVERSITY COLLEGE LONDON
Sub-second dopamine fluctuations in human striatum during active decision-making

Professor Bryan Mowry
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
A genome-wide association study of schizophrenia in Southern India

Professor Peter Nestor
GERMAN CENTER FOR NEURODEGENERATIVE DISEASES, MAGDEBURG, GERMANY
The truth or the technique: imaging insights into Alzheimer's disease

Professor Bill Newsome
STANFORD SCHOOL OF MEDICINE, USA
A new look at gating: selective integration of sensory signals through network dynamics in prefrontal cortex

Professor Bill Newsome
STANFORD SCHOOL OF MEDICINE, STANFORD UNIVERSITY, CALIFORNIA, USA
Detecting covert changes-of-mind during decision-making

Professor Bill Newsome
STANFORD SCHOOL OF MEDICINE, STANFORD UNIVERSITY, CALIFORNIA, USA
The US BRAIN initiative

Dr Jess Nithianantharajah
FLOREY INSTITUTE OF NEUROSCIENCE AND MENTAL HEALTH, THE UNIVERSITY OF MELBOURNE
Genes and synapses: dissecting the basis of cognition and mental diseases

Professor Daniel Osorio
UNIVERSITY OF SUSSEX, UK
Evolution of animal colour vision

Associate Professor Stephan Pless
UNIVERSITY OF COPENHAGEN, DENMARK
Using an expanded genetic code to study ion channel function and pharmacology at the atomic level

Professor Willi Ribi
PRIVATE UNIVERSITY OF THE PRINCIPALITY OF LIECHTENSTEIN
Insect ocelli, eyes for every function: results of traditional and X-ray CT techniques

Professor Phil Robinson
CHILDREN'S MEDICAL RESEARCH INSTITUTE, THE UNIVERSITY OF SYDNEY
Shape-shifting dynamin: multiple dynamin conformations for endocytosis and more

Dr Katherine Roche
NATIONAL INSTITUTES OF HEALTH: NINDS, PORTER NEUROSCIENCE RESERCH CENTER, BETHESDA, USA
Molecular mechanisms regulating trafficking of synaptic proteins

Dr Bruno Rossion
INSTITUTE OF RESEARCH IN PSYCHOLOGY, UNIVERSITY OF LOUVAIN, BELGIUM
Understanding face perception with fast periodic visual stimulation

Professor Paul Slesinger
ICAHN SCHOOL OF MEDICINE AT MOUNT SINAI, USA
Mechanisms underlying plasticity of potassium channel signaling with psychostimulants

Paola Spadaro
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
The role of regulatory long non-coding RNAs in adaptive behavior

Professor Charles F Stevens
THE SALK INSTUTITE, CALIFORNIA, USA
What the fly's nose tells the fly's brain

Professor Nick Strausfeld FRS
DEPARTMENT OF NEUROSCIENCE, UNIVERSITY OF ARIZONA, USA
Deep time and modern brains

Dr Rodrigo Suárez
QUEENSLAND BRAIN INSTITUTE, UNIVERSITY OF QUEENSLAND
Deep-time epigenesis of neocortical circuits (or how to make a mammalian brain)

Associate Professor Hirokazu Tanaka
JAPAN ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY, ISHIKAW, JAPAN
How the motor cortex represents body movements: a spatial dynamics model

Dr Amantha Thathiah
KATHOLIEKE UNIVERSITY, LEUVEN, BELGIUM
GPCR dysfunction in Alzheimer's disease

Hanne Thoen
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Colour vision in mantis shrimps: understanding one of the most complex visual systems in the world

Dr Nicolas Vitale
INSTITUTE OF CELLULAR AND INTEGRATIVE NEUROSCIENCES, UNIVERSITY OF STRASBOURG, STRASBOURG, FRANCE
Implication of phospholipase D1 generated phosphatidic acid in neurosecretion and neuronal development

Professor Gordon Wallace
THE INTELLIGENT POLYMER RESEARCH INSTITUTE, UNIVERSITY OF WOLLONGONG
3D bioprinting: new dimensions for bionics

Professor Eric Warrant
DEPARTMENT OF BIOLOGY, UNIVERSITY OF LUND, SWEDEN
Seeing at the limits: vision and visual navigation in nocturnal insects

Professor Marcelo Wood
UNIVERSITY OF CALIFORNIA, IRVINE, USA
The role of nucleosome remodeling in synaptic plasticity, memory, and intellectual disability disorders

Associate Professor Jian Yang
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Estimating genetic variation for human complex traits and common diseases using whole genome sequence data

Xianfeng Yang
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Diffeomorphic metric mapping, brain shape analysis and imaging genetics

Dr Giles Yeo
UNIVERSITY OF CAMBRIDGE METABOLIC RESEARCH LABORATORIES, WELLCOME TRUST-MRC INSTITUTE OF METABOLIC SCIENCE, ADDENBROOKE'S HOSPITAL, CAMBRIDGE, UK
Considering obesity as a chronic brain disease

Dr Jai Yu
UCSF SANDLER CENTER FOR INTEGRATIVE NEUROSCIENCES, SAN FRANCISCO, USA
Cortical-hippocampal interactions in adaptive decision making

Oressia Zalucki
QUEENSLAND BRAIN INSTITUTE, THE UNIVERSITY OF QUEENSLAND
Presynaptic mechanisms of general anaesthesia in Drosophila melanogaster

Dr Steven Zuryn
INSTITUTE OF GENETICS AND MOLECULAR AND CELLULAR BIOLOGY (IGBMC), STRASBOURG, FRANCE
Epigenetic determination of biological robustness: perfecting hindgut-to-motor neuron transdifferentiation

Conferences

Cortical Connections

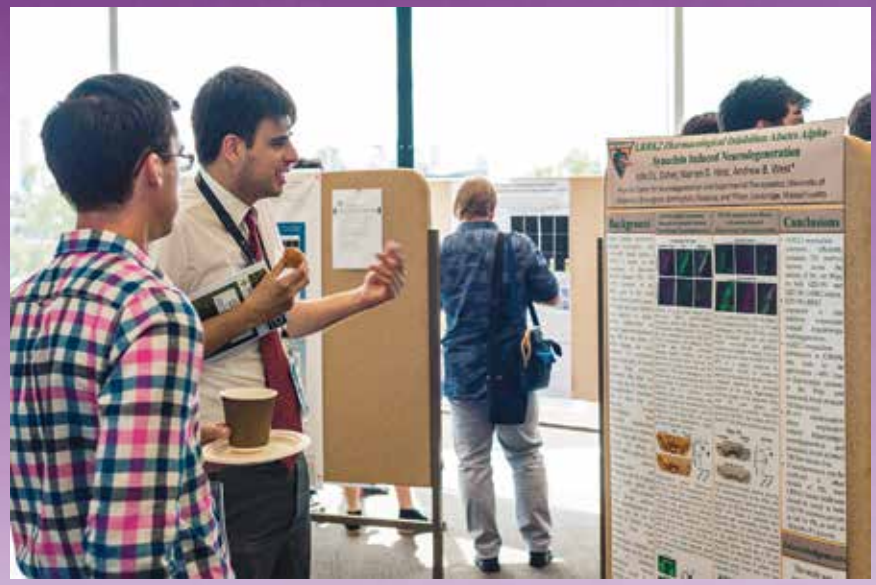
QBI HOSTED CORTICAL Connections from March 19–20, a unique conference that resulted in the formation of an international consortium looking to understand the function and development of the corpus callosum and disorders of cerebral connectivity.

Organised by Professor Linda Richards, the conference brought together international leaders in the field of brain wiring, with a focus on the function and development of the corpus callosum, as well as developmental disorders of brain wiring.

"We attracted leaders working across the fields of brain development, the genetics of cortical malformations, brain imaging of brain wiring disorders, and researchers investigating the neuropsychological outcomes of people with corpus callosum and brain wiring disorders," Professor Richards said. "By bringing these people together we also had the opportunity to form a terrific new international consortium called the International Research Consortium for the Corpus Callosum and Cerebral Connectivity (IRC5)," she said.

International consortium members come from the USA, France and Brazil, and domestically from UQ, Murdoch Children's Research Institute, and the Florey Institute of Neuroscience and Mental Health. The group will share data for people with corpus callosum malformations, which have an incidence of around one in 3,000 people.

The Cortical Connections conference also hosted a Workshop on autism spectrum disorder (ASD)—a satellite meeting to Cortical Connections, presented by A Clear Direction Financial Planning, which was attended by 200 members of the community, including health workers, physicians working with ASD individuals and families.



9th Alzheimer's + Parkinson's Disease Symposium

FROM APRIL 23–24, QBI was host to more than 191 researchers from throughout Australia and across the globe for the 9th Alzheimer's and Parkinson's Disease (A+PD) Symposium.

The two-day program had a number of keynote lectures, shorter talks and workshops. Keynote lectures were given by Professor Takaomi Saido (Riken), Professor Christian Czech (Roche Pharma Ltd, Basel), Professor Matthew Kiernan (University of Sydney), Professor Kim Green (University of Califromia Irvine), Professor Victor Villemange (University of Melbourne), Professor Jia Jianping (Hospital of Beijing Capital Medical University) and Professor Frank La Ferla (University of California Irvine).

CJCADR Director Professor Jürgen Götz (QBI) and Professor Lars Ittner (The University of New South Wales) organised the event.

The 10th A+PD Symposium will be held in May 2016 at QBI.

Above: A poster session at the 9th A+PD symposium.

Systems & Computational Neuroscience Down Under (SCiNDU)

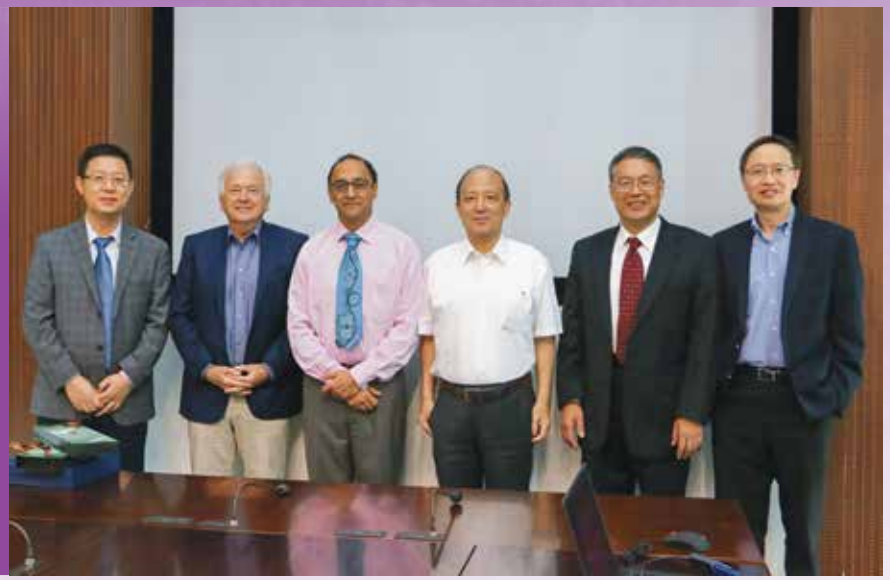
PROFESSOR GEOFFREY GOODHILL hosted the SCiNDU conference held at QBI from December 15–17 2015. The conference focused on understanding the computational principles underlying how neural circuits decode sensory information, make decisions, and learn from experience.

The exciting three-day program consisted of lectures, a poster session with 70 posters presented and two tutorials. The conference featured several international guest speakers including Mark Bear (MIT), Zach Mainen (Champalimaud), Yang Dan (UC Berkeley), Peter Dayan (UCL), and Li Zhaoping (UCL). Local speakers included Ehsan Arabzadeh (ANU), Michael Breakspear (QIMR), Peter Robinson (Sydney), Marcello Rosa (Monash), Greg Stuart (ANU) and from QBI Group Leaders, Allen Cheung, Marta Garrido, Geoffrey Goodhill, Jason Mattingley, Linda Richards, Pankaj Sah, Mandyam Srinivasan and Stephen Williams.

SCiNDU was attended by 180 registrants, many of whom travelled internationally and across Australia to attend the conference.

Keynote speakers at the Cortical Connections conference hosted by QBI.

International collaborations



In 2015, QBI researchers continued to collaborate with scientists around the world, ranging across North America, the United Kingdom, Europe, India and Japan.

2015 ALSO SAW the development of further collaborations with research institutes in China.

In addition to joint laboratories with the Second Military Medical University, the Chinese Academy of Sciences' Institute of Biophysics (IBP) and the Chinese Academy of Sciences' Institute of Automation (CASIA), QBI is strengthening connections with neuroscience researchers at the South University of Science and Technology of China.

Above: Research collaboration meeting at the South University of Science and Technology of China (SUSTC). L–R: Professors Hou Shengtao (Director, Global Engagement Office and Director, Neuro-Cognitive Research Centre, SUSTC), Perry Bartlett, Pankaj Sah, Chen Shiyi (President, SUSTC), Wu Chuanyue (Vice-President for Education and Chair Professor of Biology, SUSTC) and Chen Linzhao (visiting Professor from Johns Hopkins University).

Munich Center for Neurosciences

3rd QBI-MCN Symposium
Constructing the integrated brain: neurons, circuits and cognition

FROM OCTOBER 7–9 QBI hosted its third joint symposium with the Munich Centre for Neurosciences (MCN), which was attended by more than 130 international and local researchers.

The program was held over three days and included a series of lectures, topic-specific sessions, and a poster session.

The successful QBI—MCN symposium brought together leading researchers in circuits, cognitive, and cellular and molecular neuroscience to share their recent findings with the Australian neuroscience community.

Above: Professor Benedikt Grothe, Founder, Munich Center for Neurosciences speaking at the QBI—MCN symposium.

Our scientists have strong international research partnerships with colleagues all over the world.

Dr Victor Anggono

- Professor Richard L Huganir, The Johns Hopkins University School of Medicine, USA
- Professor Se-Young Choi, Seoul National University, South Korea
- Dr Bo-Shiun Chen, Georgia Regents University, USA

Professor Perry Bartlett

- Professor Rongqiao He, QBI-IBP Joint Laboratory of Neuroscience and Cognition, Institute of Biophysics, China
- Professor Huji Xu, Joint Sino-Australian Neurogenetics Laboratory, Second Military Medical University, China
- Professor Vidita Vaidya, Tata Institute of Fundamental Research, India
- Professor Dongyuan Zhao, Fudan University, China
- Professor Shengtao Hou, South University of Science and Technology China, China

Dr Timothy Bredy

- A/Professor Nicolas Singewald, University of Innsbruck, Austria
- A/Professor Tod Kippin, University of California, Santa Barbara, USA
- Dr Haruhiko Bito, University of Tokyo, Japan
- Dr Arvind Kumar, CSIR-CCMB, India
- A/Professor Boyer Winters, University of Guelph, Canada
- Assistant Professor Robert Spitale, University of California, Irvine, USA

International collaborations

Associate Professor Thomas Burne

- Professor Richard Gronostasjki, State University of New York, USA
- Dr Antony Isles, Cardiff University, UK
- Professor Vincent Jaddoe, Erasmus Medical Center, The Netherlands
- Professor Preben Mortensen, Aarhus University, Denmark
- Professor Elliot Sheer, University of California, San Francisco, USA
- Dr Jared Young, University of California, San Diego, USA

Associate Professor Helen Cooper

- Dr Cecilia Flores, Douglas Mental Health University Institute, Canada
- Dr Jean-Francois Cloutier, McGill University, Canada
- Dr Hiroshi Tawarayama, Kumamoto University, Japan

Professor Elizabeth Coulson

- Professor Jakob Hort, Charles University, Czech Republic
- Professor Carlos Ibanez, Karolinska Institute, Sweden and National University of Singapore, Singapore
- Professor Anders Nykjaer, Aarhus University, Denmark

Professor Barry Dickson

- Professor Ansgar Büschges, University of Cologne, Germany
- Professor Richard Mann, Columbia University, USA
- Professor Kristin Scott, University of California, Berkeley, USA
- Dr Gwyneth Card, HHMI Janelia Research Campus, USA

Dr Allen Cheung

- Dr Caswell Barry, University College London, UK
- Professor Jeffery Taube, Dartmouth College, USA

Professor Ross Cunnington

- Professor Christian Windischberger, Medical University of Vienna, Austria
- Professor Jorge Moll, D'Or Institute for Research and Education, Brazil
- Professor David Huepe, Universidad Diego Portales, Chile

Professor Darryl Eyles

- Dr Erik Cederfjall, Lund University, Sweden
- Dr Elisabeth Fernell, Karolinska Institute, Sweden
- Dr Oliver Howes, Imperial College London, UK
- A/Professor Brian Lee, Drexel University, USA
- Dr Urs Meyer, ETH Zurich, Switzerland
- National Institutes of Health, USA
- Assistant Professor Rebecca Schmidt, University of California, Davis, USA
- Dr Pamela Von Hurst, Massey University, New Zealand
- Dr Gayle Windham, Division of Environmental and Occupational Disease Control, USA

Professor Geoffrey Goodhill

- University of Cardiff, UK
- University College London, UK

Professor Jürgen Götz

- Professor Mel Feany, Harvard University, USA
- Dr Matthias Staufenbiel, DZNE, Germany
- Professor Hannsjörg Schröder and Dr Christoph Köhler, University of Cologne, Germany
- Professor Johannes Attems, University of Newcastle, UK
- Professor Sylvain Lesne, University of Minnesota, USA

Associate Professor Massimo Hilliard

- Dr Paolo Bazzicalupo and Dr Elia Di Schiavi, Institute of Biosciences and Bioresources, Italy
- Professor Hang Lu, Georgia Institute of Technology, USA
- Professor Ding Xue, University of Colorado, USA
- Professor Yun Zhang, Harvard University, USA

Dr Zhitao Hu

- Professor Josh Kaplan, Harvard University, USA
- Professor Tao Xu, Chinese Academy of Sciences, Institute of Biophysics, China
- A/Professor Jeremy Dittman, Cornell University, USA
- Assistant Professor Kavita Babu, Indian Institute of Science Education and Research (IISER), India
- Professor Zhiqi Xiong, Institute of Neuroscience, Chinese Academy of Sciences, China

Professor Tianzi Jiang

- Juelich Research Center, Germany
- Stem Cell and Brain Research Institute, INSERM U846, France

Professor Joe Lynch

- Professor Rob Harvey, University College London, UK
- Professor Carmen Villmann, University of Wurzburg, Germany
- Professor Andrew Jenkins, University of Alabama, USA
- Professor Neil Harrison, Columbia University, USA
- Professor Richard Olsen, University of California, Los Angeles, USA
- Dr Stephan Pless, Danish School of Pharmacy, Denmark

Professor Jason Mattingley

- Dr Tristan Bekinschtein, University of Cambridge, UK
- Professor Mark Greenlee, University of Regensburg, Germany
- Dr Redmond O'Connell, Trinity College Dublin, Ireland

Professor John McGrath

- Professor Ron Kessler, World Mental Health Survey, Harvard Medical School, USA
- Professor Preben Mortensen, National Centre for Register-based Research, Aarhus University, Denmark
- Dr Fiona Gaughran, Institute of Psychiatry, Kings College London, UK
- Dr Henning Tiemier and Dr Vincent Jaddoe, Erasmus Medical Centre, Netherlands
- Dr Christina Dalman and Dr Renee Gardiner, Karolinska Institute, Sweden
- Dr Brian Lee, Drexel University, USA

International collaborations

Dr Fatima Nasrallah

- Professor Edward Koo, Department of Neurosciences, University of California, San Diego, USA
- Professor Allen Yeo, National University Hospital, Singapore
- David Townsend, Clinical Imaging Research Centre, Singapore

Dr Michael Piper

- Professor Francois Guillemot, MRC National Institute for Medical Research, UK
- Emeritus Professor Matthew Scott, Stanford University, USA
- Professor Richard Gronostajski, State University of New York, USA
- Associate Professor Christine Jasoni, University of Otago, New Zealand

Professor Linda Richards

- Professor Elliott Sherr, University of California, San Francisco, USA
- Professor James Barkovich, University of California, San Francisco, USA
- Professor William Dobyns, University of Washington, USA
- Professor Richard Gronostajaki, State University of New York, USA
- Professor Hideuki Okano, Keio University School of Medicine, Japan
- Professor Alessandra Pierani, INSERM U846, France

Professor Pankaj Sah

- Professor Andreas Luthi, Fredrich Meischer Research Institute, Switzerland
- Professor Shengtao Hou, South University of Science and Technology of China
- Professor Jianyuan Sun, Institute of Biophysics, Chinese Academy of Sciences, Beijing

Professor Mandyam Srinivasan

- Dr Partha Bhagavatula, Department of Organismic and Evolutionary Biology, Harvard University, USA

Associate Professor Bruno van Swinderen

- Assistant Professor Paul Shaw, Washington University School of Medicine, USA
- Professor Li Liu, Institute of Biophysics, China

Professor Peter Visscher

- Professor Ian Deary, The Epigenome of the Lothian Birth Cohort, University of Edinburgh, Scotland
- Professor Michel Georges, University of Liege, Belgium
- Professor Bill Hill, University of Edinburgh, Scotland
- Professor Joel Hirschhorn, Genetic Investigation of Anthropometric Traits (GIANT) Consortium, Harvard, USA
- Assistant Professor Matt Keller, University of Colorado, USA
- Professor Phillip Koellinger, Social Sciences Genetic Association Consortium, University of Amsterdam, Netherlands
- Professor Mick O'Donovan, Psychiatric Genomics Consortium for Schizophrenia, Wales
- Dr Stephan Ripke, Psychiatric Genomics Consortium for Statistical Analysis, Harvard & Berlin, USA & Germany
- Professor Bruce Weir, University of Washington, USA
- Professor John Witte, University of California, San Francisco, USA

Professor Naomi Wray

- Professor Ian Deary, The Epigenome of the Lothian Birth Cohort, University of Edinburgh, Scotland
- Professor Jack Hettema, International Consortium for Genetics of Anxiety Disorders, Virginia Commonwealth University, USA
- Professor Elliot Nelson, Washington University, USA
- Professor Brenda Penninx, Vrije Universiteit Amsterdam, Netherlands
- Professor Soumya Raychaudhuri, Harvard University, USA
- Professor Thomas Schulze, International Consortium for Lithium Genetics, Germany
- Professor Patrick Sullivan, University of North Carolina, USA & Karolinska Institute, Sweden

Associate Professor Margie Wright

- Professor Paul Thompson, Queensland Twin Imaging Study (QTIM) and Enhancing Neuro Imaging through Genetic Meta Analysis (ENIGMA) Consortium, University of Southern California, USA
- Professor Andreas Meyer-Lindenberg, IMAging GEnetics for MENtal Disorders (IMAGEMEND) Consortium, Central Institute of Mental Health, Mannheim, Germany
- ENIGMA Consortium
- Professor Danielle Reed, Monell Chemical Senses Center, USA

Associate Professor Jian Yang

- Professor Daniel Benjamin, Social Sciences Genetic Association Consortium, Cornell University, USA
- Professor Timothy Frayling, Genetic Investigation of Anthropometric Traits (GIANT) Consortium, University of Exeter, UK
- Professor Zibing Jin, Wenzhou Medical University, China
- Associate Professor Alkes Price, Harvard University, USA
- Assistant Professor Noah Zaitlen, University of California, San Francisco, USA

UQ appointments

Professor Perry Bartlett

- Academic Board
- Advancement Sub-Committee
- Anthropology Museum Management Committee
- Centre for Advanced Imaging Advisory Board
- Health and Medical Research Advancement Board
- University Senior Management Group

Associate Professor Thomas Burne

- Anatomical Biosciences Animal Ethics Committee, Chair and Category B Member
- Enhancing Systems and Services, Animal Ethics Project Team Member

Mr Jake Caroll

- UQ Information Technology Consultative Group

Associate Professor Helen Cooper

- Institutional Biosafety Committee
- Master of Neuroscience Program Co-ordinator
- MPhil in Neuroscience Co-ordinator

Professor Elizabeth Coulson

- Deputy Chair of Local Appointments and Promotions Committee

Professor Darryl Eyles

- Centre for Advanced Imaging Small Animal Imaging Committee, Vice-Chair

Professor Geoffrey Goodhill

- Anatomical Biosciences Animal Ethics Committee

Professor Jürgen Götz

- UQBR Animal Users Advisory Committee

Associate Professor Massimo Hilliard

- Library Advisory Committee

Mr John Kelly

- Biological Resources Committee
- National Imaging Facility
- Infrastructure Sub-Committee
- Professional and Academic Staff Consultative Committees
- Vice-Chancellor's Risk Compliance Committee

Professor Joe Lynch

- Research Integrity Advisor

Professor John McGrath

- Queensland Centre for Mental Health Research, Director

Dr Michael Piper

- Animal Ethics Committee

Professor Linda Richards

- Associate Deans/Deputy Deans/Institute Deputy Directors (Research) Committee
- UQ Research Committee
- Child Health @ UQ Committee
- Enhancing Systems and Services Discovery Committee

Professor Pankaj Sah

- University Senior Management Committee
- UQ Research Committee

Professor Stephen Williams

- Australian Course in Advanced Neuroscience, Director
- Research Higher Degree Committee

Professional service

Dr Victor Anggono

- NHMRC Project Grant Reviewer
- Health Research Council, New Zealand, Project Grant Reviewer

Professor Perry Bartlett

- Brainnetome Center, Institute of Automation, The Chinese Academy of Sciences, Beijing, International Advisory Committee
- Centre for Brain Research, University of Auckland, Scientific Advisory Board
- Garvan Institute of Medical Research, University of New South Wales, Scientific Appointments and Promotions Committee
- Mater Medical Research Institute Limited, Board of Directors, Member
- Motor Neurone Disease Research Institute of Australia, Research Committee
- Science of Learning Research Centre, Advisory Board Member
- SpinalCure Australia Director and Scientific Board Chairman

Dr Timothy Bredy

- Agence Nationale de la Recherche, France, Grant Reviewer
- European Commission Horizon 2020, Grant Reviewer
- Fonds Nationale de la Recherche, Luxembourg, Grant Reviewer
- Canadian Institutes of Health Research, Grant Reviewer

Associate Professor Thomas Burne

- Biological Psychiatry Australia, Secretary and Committee Member
- NHMRC Grant Review Panel Member
- Society for Mental Health Research, Queensland Representative, Early Career Research Fellowship Panel Member
- Rebecca L Cooper Fellowship, Committee Member

Associate Professor Helen Cooper

- Australian Huntington's Disease Association, Queensland Branch, QBI Representative
- Brisbane Chapter of the American Society for Neuroscience, Committee Member
- NHMRC Assigners Academy
- Local organising committee for the Society of Mental Health Research
- Queensland Representative, Australasian Neuroscience Society

Professor Elizabeth Coulson

- Alzheimer's Australia Dementia Research Foundation, Scientific and Medical Panel Member
- International Society for Neurochemistry Summer School, Organising Committee
- NHMRC Assigner's Academy Member
- The Mason Foundation Scientific Board

Professor Ross Cunnington

- Australasian Cognitive Neuroscience Society, Executive Committee
- BIOMAG 2016 International Conference on Biomagnetism, Korea, Scientific Committee
- International Conference on Cognitive Neuroscience 2017, Netherlands, Scientific Committee

Professor Barry Dickson

- EMBO-Kavli Workshop on Neural Circuits and Behaviour of Drosophila, Co-organiser
- HHMI Janelia Research Campus Workshop on Motor Control Circuits, Co-organiser
- International Society for Neurochemistry Flagship School: The Malleable Brain, Co-organiser
- European Molecular Biology Organization, Member
- American Association for the Advancement of Science, Fellow
- Austrian Academy of Science, Corresponding Member

Professor Darryl Eyles

- Biological Psychiatry Australia, Vice-President
- NSW Brain Bank Network, Scientific Review Committee

Professor Geoffrey Goodhill

- NHMRC Grant Review Panel

Professor Jürgen Götz

- Alzheimer Research Forum, Member
- NHMRC and ARC Grant Reviewer
- Dementia Fellowships Grant Reviewer
- Joint Project Neurodegenerative Diseases (EU Initiative), Grant Review Panel
- NHMRC National Institute for Dementia Research, Expert Advisory Panel

Associate Professor Massimo Hilliard

- NHMRC Grant Review Panel

Professor Tianzi Jiang

- Brainnetome Branch of the Chinese Society for Anatomical Sciences, President
- Chinese Society for Anatomical Sciences, Standing Member of Board of Directors
- Chinese Society for Cognitive Science, Board of Directors Member
- Hunan Key Laboratory of Diagnosis and Therapy of Psychiatry, Scientific Committee Deputy Chair
- Institute of Automation of the Chinese Academy of Sciences, Scientific Committee Member
- Key Laboratory for NeuroInformation of the Ministry of Education of China, Scientific Committee Member
- Tianjin Key Laboratory of Brain Functional Imaging, Scientific Committee Chair

Professional service

Professor Joe Lynch

- Australian Course in Advanced Neuroscience, Scientific Program Advisory Group Member
- Australasian Neuroscience Society, Secretary
- Glycine Receptor Nomenclature Committee of the International Union of Basic and Clinical Pharmacology, Chair
- International Society for Neurochemistry Congress, Programming Committee

Professor Jason Mattingley

- Academy of Social Sciences in Australia, Panel D (Psychology, Social Medicine, Education) Committee Member
- Association for Attention and Performance, Advisory Council Member
- ARC College of Experts
- ARC Centre of Excellence for Cognition and its Disorders, Scientific Advisory Committee Member
- Australian Academy of Science, National Committee for Brain and Mind, Member

Professor John McGrath

- Australian Schizophrenia Research Bank, Access Committee
- ANZ Trustees Queensland Medical Program Review Committee
- NHMRC Australian Health Ethics Committee
- NHMRC Research Committee
- NHMRC Grant Review Panel Member
- Orygen Youth Health Research Centre, Research Committee
- Research Australia Board Member
- Schizophrenia International Research Society, Board Member
- Schizophrenia Research Forum, Advisory Board Member

Dr Michael Piper

- Australian and New Zealand Society for Cell and Developmental Biology, Treasurer
- Australasian Neuroscience Society, Queensland Representative
- NHMRC Assigners Academy, Member

Professor Linda Richards

- Australian Disorders of the Corpus Callosum (AusDOCC), Scientific Advisor
- NHMRC Grant Review Panel

Professor Pankaj Sah

- Australian Course in Advanced Neuroscience, Course Management Committee
- Multiple Sclerosis Australia, Grant Review Panel Member
- NHMRC Assigners Academy, Member
- NHMRC Career Development Fellowship Panel
- Science of Learning Research Centre, Executive Committee

Professor Mandyam Srinivasan

- Council, Australian Academy of Science
- National ICT Australia Ltd, Research Evaluation Committee
- Cold Spring Harbor Asia Conferences, Scientific Advisory Board
- Australasian Conference on Robotics and Automation, Program Committee

Professor Peter Visscher

- Medical Services Advisory Committee Working Group for Evaluation of Genomic "Black Boxes", Member
- Centre for Cognitive Ageing and Cognitive Epidemiology, University of Edinburgh, Member
- Social Science Genetics Association Consortium, Advisory Board
- World Congress Psychiatric Genetics 2016, Jerusalem, Scientific Committee
- Medical Genomics Reference Bank (NSW Department of Health/Garvan Institute of Medical Research), Strategic Advisory Committee

Professor Stephen Williams

- NHMRC Grant Review Panel

Professor Naomi Wray

- NHMRC Research Fellowship Committee
- Member of the Medical Services Advisory Committee Working Group for Evaluation of Genomic "Black Boxes"
- Anorexia Nervosa Genetics Initiative, Scientific Advisory Board
- Consortium for Lithium Genetics, Advisor
- World Congress Psychiatric Genetics 2016, Jerusalem, Scientific Committee
- World Congress Psychiatric Genetics 2017, Orlando, Scientific Committee

Associate Professor Margie Wright

- Enhancing Neuro Imaging through Genetic Meta Analysis (ENIGMA) Consortium, Scientific Advisory Group Member

Associate Professor Jian Yang

- NHMRC Grant Review Panel

Dr Steven Zuryn

- Genetics Society of America, Member
- Australia and New Zealand Society for Cell and Developmental Biology, Member

QBI staff at the 2015 Annual Institute Lunch.

People

QBI is home to more than 450 staff and students.

Whether researcher, student, or professional staff member, each individual plays an important role in the success of the Institute.

QBI executive, faculty and affiliates

Director

Professor Perry Bartlett
(until 30 June 2015)

Professor Pankaj Sah
(commenced 1 July 2015)

Deputy Director (Research)

Professor Pankaj Sah
(until 30 June 2015)

Professor Linda Richards
(commenced 3 August 2015)

Deputy Director (Operations)

John Kelly

Faculty

Dr Victor Anggono
Professor Perry Bartlett
Dr Timothy Bredy
Associate Professor Thomas Burne
(Conjoint Appointment)
Dr Allen Cheung
Associate Professor Kai-Hsiang Chuang
Associate Professor Helen Cooper
Professor Elizabeth Coulson
Professor Ross Cunnington
Professor Barry Dickson
Associate Professor Darryl Eyles
Professor Juergen Goetz
Professor Geoffrey Goodhill
Associate Professor Massimo Hilliard
Dr Zhitao Hu
Professor Tianzi Jiang
Professor Joseph Lynch
Dr Marie Mangelsdorf
Professor Justin Marshall
Professor Jason Mattingley
Professor John McGrath
(Conjoint Appointment)
Professor Frederic Meunier
Professor Bryan Mowry
(Conjoint Appointment)
Dr Fatima Nasrallah
Mr Geoffrey Osborne
Dr Michael Piper
Professor Linda Richards
Professor Pankaj Sah
Professor Mandyam Srinivasan
Associate Professor Bruno van Swinderen
Professor Peter Visscher
Dr Jana Vukovic
Professor Stephen Williams
Professor Naomi Wray
Associate Professor Margaret Wright
Professor Huji Xu
Associate Professor Jian Yang
Dr Steven Zuryn

University of Queensland affiliates

Dr Marie-Jo Brion
Professor Matthew Brown
Professor Robert Capon
Dr Karen Cheney
Dr Brett Collins
Dr Fabio Cortesi
Associate Professor Terrence Coyne
Associate Professor Paul Dux
Dr Hannah Filmer
Professor Wayne Hall
Associate Professor Julie Henry
Dr Marc Kamke
Dr David Kvaskoff
Dr Stanley Millard
Dr Samuel Nayler
Associate Professor Peter Noakes
Dr Joseph Powell
Dr Melody Puckridge
Professor David Reutens
Dr Eva-Maria Reuter
Dr Marc Ruitenberg
Dr Ethan Scott
Dr Sonia Shah
Dr Ji Shin
Professor Peter Silburn
Dr Surya Singh
Dr Hari Subramanian
Professor Walter Thomas
Dr Jeremy Ullmann
Dr Lata Vadlamudi
Dr Oressia Zalucki

Adjunct appointments

Dr Jeff Bednark
Professor Mark Bellgrove
Dr Gabriela-Oana Bodea
Dr Tarrant Cummins
Associate Professor Geoffrey Faulkner
Dr Yakir Gagnon
Dr Ziarih Hawi
Dr Martin How
Sujit John
Dr Hong Lee
Dr Bill Mantzioris
Dr Riccardo Marioni
Professor Geofferey Masters
Dr Weichuan Mo
Associate Professor Grant Montgomery
Dr Cornelia Strobel
Dr Shuichi Suetani
Associate Professor Yajing Sun
Dr Rangaswamy Thara
Dr Robyn Wallace
Dr Zhengyi Yang
Dr Steven Zuryn

Conjoint appointments

Dr Duncan Mclean
Dr Sathish Periyasamy
Dr Sukanta Saha
Dr Rachel Suetani

Emeritus Professors

Professor Jack Pettigrew
Professor David Vaney

Honorary Professors

Professor David Adams
Professor Mark Bellgrove
Professor Charles Claudianos
Professor Shaun Collin
Professor Christian Gericke
Professor Gisela Kaplan
Professor Ottmar Lipp
Professor Nicholas Martin
Professor Hideyuki Okano
Professor Tristan Perez
Professor Lesley Rogers
Professor Seong-Sen Tan
Professor Charles Watson

QBI researchers

Honorary researchers

Dr Tony Dreise
Dr Christine Guo
Dr David Kvaskoff
Dr Thai Vinh Nguyen
Dr Judith Reinhard
Associate Professor Michael Wilson

Academic title holders

Associate Professor
Robert Henderson

Postdoctoral fellows

Dr Eleonora Autuori
Dr Lilach Avitan
Dr Corinne Bareham
Dr Oliver Baumann
Dr Jeff Bednark
Dr Beben Benyamin
Dr Jesus Bertran Gonzalez
Dr Daniel Blackmore
Dr Liviu Bodea
Dr Marie-Jo Brion
Dr Arne Brombas
Dr Jens Bunt
Dr Enda Byrne
Dr Marie Camara
Dr Guo-Bo Chen
Dr Wen-Sung Chung
Dr Sean Coakley
Dr Luca Cocchi
Dr Lavinia Codd
Dr Florence Cotel
Dr Alexandre Cristino
Dr Xiaoying Cui
Dr Fanny de Busserolles
Dr Simon De Croft
Dr Christine Dixon
Dr Nela Durisic
Dr Argel Estrada
Dr Kai Feng
Dr Javed Fowdar
Dr Yakir Gagnon
Dr Marta Garrido
Dr Jean Giacomotto
Dr Rosina Giordano-Santini
Dr Ilan Gobius
Dr Helen Gooch
Dr Martyna Grabowska
Dr Jake Gratten
Dr William Harrison
Dr Robert Hatch
Dr Md Robiul Islam
Dr Dhanisha Jhaveri
Dr Merja Joensuu
Dr Marc Kamke
Dr Angelo Keramidas
Dr Georg Kerbler
Dr Peter Kozulin
Dr Vanessa Lanoue
Dr Aoife Larkin
Dr Hong Lee
Dr Chuanzhou Li
Dr Lei Li
Dr Yonghui Li
Dr Haowen Liu
Dr Luke Lloyd-Jones
Dr Jing Lu
Dr Wei Luan
Dr RogerMarek
Dr Sally Martin
Dr Ramon Martinez-Marmol
Dr Allan Mcrae
Dr Ellen Meelkop
Dr Divya Mehta
Dr John Morris
Dr Gerhard Moser
Dr Ramesh Narayanan
Dr Brent Neumann
Dr Shyuan Ngo
Dr Rebecca Nisbet
Dr Christopher Nolan
Dr Conor O'leary
Dr Maryam Odabaee
Dr Kathie Overeem
Dr Pranesh Padmanabhan
Dr Andreas Papadopulos
Dr Juan Polanco
Dr Joseph Powell
Dr Alexander Puckett
Dr Lei Qian
Dr Margaretha Ridder
Dr Matthew Robinson
Dr Philip Robinson
Dr Martin Sale
Dr Miriam Sanchez Matamales
Dr Ingo Schiffner
Dr Sonia Shah
Dr Konstantin Shakhbazov
Dr Benjamin Sivyer
Dr Hussein Srour
Dr Sara Stieb
Dr Peter Stratton
Dr Cornelia Strobel
Dr Rodrigo Suarez
Dr Robert Sullivan
Dr Men Tan
Dr Matthew Tang
Dr Chanel Taylor
Dr Hanne Thoen
Dr Vanesa Tomatis
Dr Maciej Trzaskowski
Dr Fabrice Turpin
Dr Anna Vinkhuyzen
Dr Tong Wang
Dr Wei Wei
Dr Jocelyn Widagdo
Dr Nicole Wilson
Dr François Windels
Dr Futao Zhang
Dr Qiongyi Zhao
Dr Zhihong Zhu

Research officers

Leonie Kirszenblat
Xiang Li
Samuel Nayler
Matthew Robinson

Research assistants

Suzanne Alexander
Kathy Asmussen
Andrew Baker
Andrew Bakshi
Stephanie Bell
Arne Brombas
Tim Butler
Yu Chau
Linda Cumner
Cheryl Filippich
Lee Fletcher
Ka Fok
Brookes Folmli
Alan Goldizen
Rachel Gormal
Julia Groening
Justine Haddrill
Kyra Hay
Amy Heffernan
Alexander Holloway
Oscar Jacoby
Simranpreet Kaur
Anna Kleine
Michael Knight
Pauline Ko
Apurva Kumar
Laura Leighton
Benjamin Lewis
David Lloyd
Chang Liu
Andrew Martin
Gregory Medley
Michael Milne
Tam Nguyen
Zoie Nott
Abbey Nydam
Imogen O'keeffe
Kelsey Palghat
Tishila Palliyaguru
Matthew Pelekanos
Rachel Petro
Thomas Pollak
Dr Zac Pujic
Vikram Ratnu
Timothy Reeks
Fiona Ritchie
Gregory Robinson
Elise Rowe
Bree Rumballe
Petra Sedlak
Henry Simila
Zala Skrbis
Peter Smartt
Heather Smith
Dean Soccol
Biao Sun
Andrea Tweedie
Hong Vo
Richard Wang
Yi Wang
Amanda White
Li Xu
Zong Zhang
Hasti Ziaimatin

QBI students

People

PhD students

Md Mamun Al-Amin
Asad Ali
Gonzalo Almarza
Joon Yong An
Mohammed Atif
Adekunle Bademosi
Danay Baker-Andresen
Siân Baker
Madhusoothanan Bhagavathi Perumal
Brendan Bicknell
Stephanie Biergans
Nicholas Bland
Zoran Boskovic
Megan Campbell
Ye Jin Chai
Justin Chaplin
Kok Siong Chen
Lavinia Codd
Baptiste Couvy-Duchesne
Nadia Cummins
Aymeric Denuelle
Daina Dickins
Alessandra Donato
Ilvana Dzafic
Laura Fenlon
Lee Fletcher
Andrea Giorni
Natalie Groves
Sumasri Guntupalli
Samuel Harley
Anthony Harris
Luke Hearne
Nicholas Hughes
Samuel Hunt
Sarah Hunt
Oscar Jacoby
Se Eun Jang
Rhiannon Jeans
Debajyoti Karmaker
Irfahan Kassam
Ravi Kiran Kasula
Georg Kerbler
Kooi Yeong Khaw
Leonie Kirszenblat
Elizabeth Kita
Michael Langford
Kiaran Lawson
Natalie Lee
Emilia Lefevre
Gerhard Leinenga
Jonathan Lim
Cirong Liu
Xiang Li
Martin Luhrmann
Anne Maallo
Robert Maier
Mahadeeswara Mandiyam
Andrew Martin
Aung Aung Kywe Moe
Laura Morcom
John Morris
Vinod Narayana
Huyen Nguyen
Morgane Nouvian
Annalisa Paolino
Alice Petty
Genevieve Phillips
Chikako Ragan
Natalie Rens
Michelle Sanchez Vega
Chase Sherwell
Cooper Smout
Ming Shiuan Soh
Paola Spadaro
Ashvin Srinivasan
Lachlan Strike
Reuben Strydom
Yajie Sun
Kristin (Chia-Hsuan) Sung
Sahil Talwar
Gavin Taylor
Rachel Templin
Hanne Thoen
Susan Travis
Michael Troup
Marion Turnbull
Karly Turner
Costanza Vallerga
Michelle Watts
Sarah Williams
Lisa Wittenhagen
Tong Wu
Yang Wu
Di Xia
Xianfeng Yang
Yuanhao Yang
Shanzhi Yan
Hon Yap
Oressia Zalucki
Yan Zhang
Jing Zhao
Mei Zhou
Xiaoqing Zhou

MPhil students

Lacey Atkins
Jennifer Pavlides
Loc-Duyen Pham

QBI professional staff

Institute Manager
Helen Weir

Grants, ethics and publications
Grants, Ethics and Publications Manager
Dr Sylvie Pichelin

Susan Day

Senior Research Manager
Rowan Tweedale

Research legal and commercialisation
Stephanie Surm

Advancement, communications and graphics
Director of Advancement and Communications
Mikaeli Costello

Carolyn Barry
Bernadette Condren
Katie Francis
Rachael Kelly
Darius Koreis
Andrea Markey
Katherine Robbins
Dr Nick Valmas

Laboratory support
Scientific Services Manager
Clare Seaman

Dr Rumelo Amor
John Baisden
Dr Dan Blackmore
Judy Bracefield
Tania Brooks
Maria Caldeira
Arthur Chien
Janette Edson
Luke Hammond
Donna Martin
Dr Daniel Matthews
Nicholas Nacsa
Virginia Nink
Emma Palfreyman
Anshu Raghuwanshi
Dr Rob Sulllivan
Janette Zlamal

Executive office
Executive Office Manager
Alison van Niekerk

Ashley Cooper
Elizabeth Cooper-Williams
Donna Lu
Rebecca Harvey
Dr Alan Woodruff

Information technology
IT Manager
Jake Carroll

Lyndon Cook (Acting)
Perry Kollmorgen
Alex Kowalczyk
Irek Porebski
Matt Savage
Michael Simpson
Gary Strachan

Human resources
HR Manager
Samantha Dyson

Jackie Perren
Maria Cummings
Emma Read
Kristy Hume
Nicole McDonald

Finance and store
Finance Analysis and Planning Manager
Anthony McRae

Anna Brancatini
Wade Ebeling
Chad Lake
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Above: QBI tools of the trade (L–R): a digital stylus, an electrophysiology patch pipette, a pick used to manipulate *C. elegans*, a pooter used for the collection of *Drosophila*, a tissue punch for sample extraction, a histology section mounting brush, electroporation forceps, and a pencil.

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