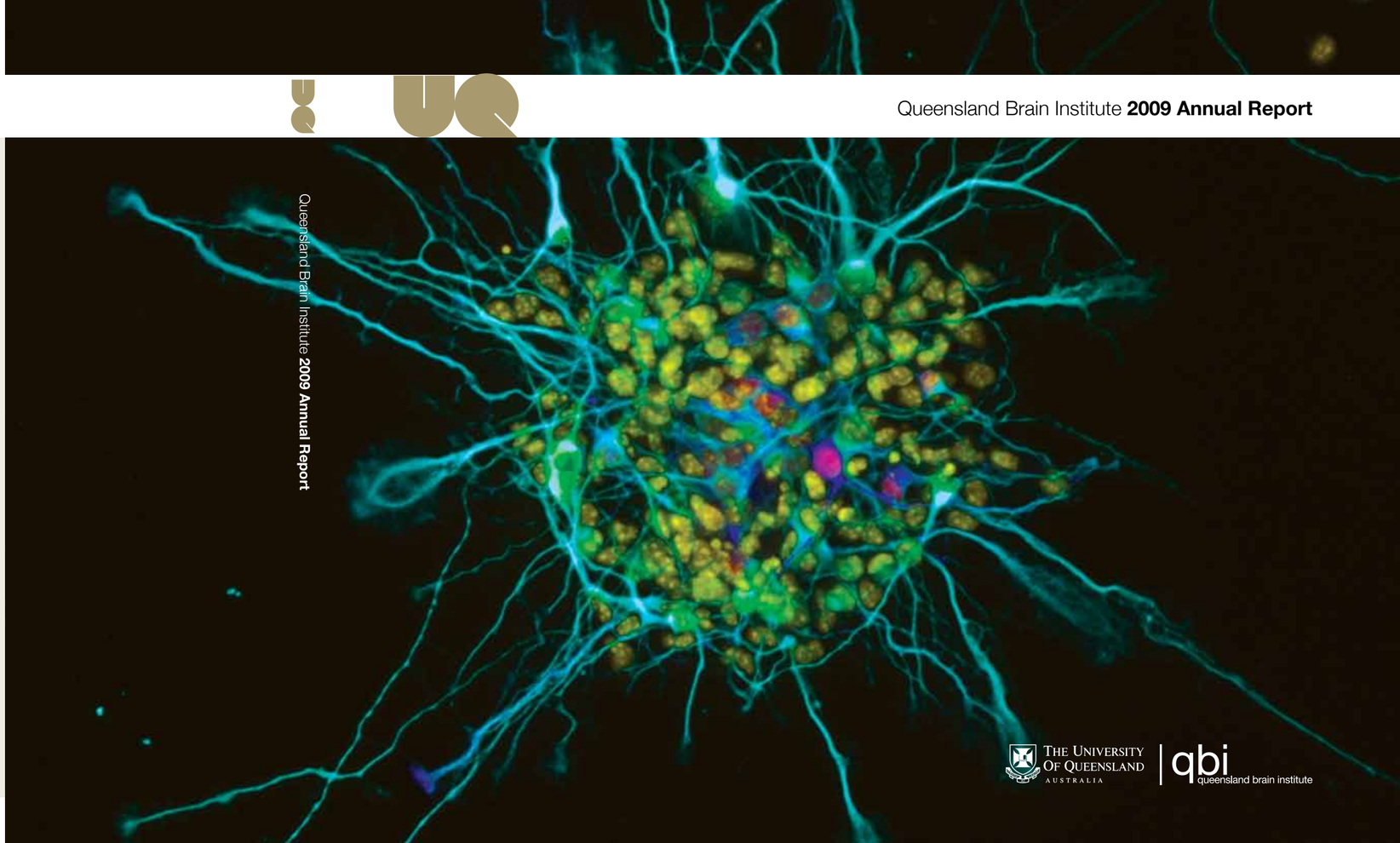
Queensland Brain Institute
Building #79, Upland Road
The University of Queensland
St Lucia QLD 4072

Telephone: +61 7 3346 6300
Facsimile: +61 7 3346 6301

Email: qbi@uq.edu.au
Website: www.qbi.uq.edu.au

The University Of Queensland AUSTRALIA | qbi queensland brain institute

Queensland Brain Institute **2009 Annual Report**



Queensland Brain Institute **2009 Annual Report**

The University Of Queensland AUSTRALIA | qbi queensland brain institute

Editor
Anna Bednarek

Graphic Designer
Dee McGrath

Photographers
Yan Chan
Stewart Gould
Ron Hohenhaus
Dee McGrath
Jeremy Patten

The University Of Queensland AUSTRALIA | qbi queensland brain institute

Australian Cancer Research Foundation

The Institute offers a sincere thank you to the following people and organisations that supported QBI in 2009.

Aero Products Pty Ltd
Alex Gow Funerals
Autotech Enterprises Pty Ltd
Bronlie Constructions Pty Ltd
David Merson Foundation
Eric Charles Development Pty Ltd
The Helpful Foundation
Hopgood Ganim Lawyers
Index Group of Companies
The Josephine Ulrick & Win Schubert Diversity Foundation
Lions Club of Emu Park Inc.
Pogliane Investments Pty Ltd
Southern Districts Rugby Union Football Club Inc
Soroptimist International Brisbane South

Susan J Andersen
Anne C Bachelard
Isabel Baldwin
Alan D Barnes
Karen Barns
Pauline Beames
Garry J Brennan
Don Bruce
Michael G Buttsworth
Tracy M Campbell
Wendy Charles
Wendy J Cornell
Colin Cross
Mary Cross
Carl D'Aguiar
Lynette E Davis
Sandra Dennis
Ross Dickson
Karl Dodd
Ray Donaldson
Gerry M Doyle
Daniel T Dredge
Erica Dunham
Donald and Anne Dunstan
Howard J Dyer
Ailcie M Foxton

Ethel Green
Donald Grimley
Nivetha Gunasekaran
Adrian C Holt
CB Horsnell
Ronald J Howatson
Glenn Howell
Eileen Howes
Desmond G Jack
SM Johnston
Kim Jones
Fiona T Kennedy
William R Lanagan
Peter J Landy
Joan M Lawrence
Elizabeth M Lindberg
Naomi J Longworth
Brenda C Lynch
Bob MacDonnell
Daphne Maclean
Hilda Maclean
David C Merefield
Louise Miller
Dane Moulton
Judith M Nedderman
Leah A Perry

Suzie J Phillips
Guy Quarterman
Eileen Reilly
Joyce I Schmidt
Ken Schmidt
Hee Sheng Shi Fashu Sim
Lorna K Sommerfeldt
Kevin Stewart
Debra Sturdy
Steven V Szokolay
Alicia Tan
David Tan
Jasmine Tan
Robin Tan
George A Taylor
David and Debra Thompson
Anthony B Toohey
Sylvia A Walker
Julie H Wall
Mark L Walsh
Mick Waters
David Webster
Cameron Withington
Carolyn R Woolley
Frank and Patsy Youngleson

Table of Contents

Vice-Chancellor's Report

Vice-Chancellor's Report

The Queensland Brain Institute has rapidly emerged as a flagship for discovery within The University of Queensland, demonstrating that high-quality infrastructure helps attract talented students, staff and collaborators, and that they in turn attract more of their calibre.

This pattern was manifest throughout 2009 when, amongst other things, the Institute exceeded early expectations and achieved a full complement of researchers, including some whose joint appointments with other areas of UQ embody the interdisciplinary nature of much of QBI's work.

New staff of 2009 include 'imports' such as Dr Timothy Bredy from the University of California, Los Angeles and Assoc. Professor Stephen Williams from the University of Cambridge, whose arrivals signify the QBI's flourishing international reputation. The Institute's capacity to secure relationships with blue-chip international research groups and companies is similarly indicative of its global ascent.

Collectively, QBI researchers have an impressive strike rate in national competitive grants schemes. In 2009, they succeeded in more than half of their submissions to both the National Health and Medical Research Council and the Australian Research Council, eclipsing national averages.

These and other flags of success indicate a sound return on investments by the Queensland Government and The Atlantic Philanthropies – which were the University's foundation partners in QBI – and by QBI's indispensible philanthropists, its connections in businesses, government and non-government organisations, and its Development Board.

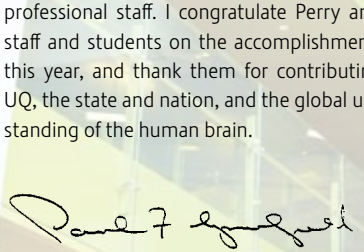
By paying close attention to training and mentoring of students and early career researchers, QBI and the University are ensuring that future progress will be long-term and sustainable.

QBI had 51 students undertaking doctoral research and two working towards Masters of Philosophy in 2009, and its first PhDs graduated in December. Both of the graduates – Drs Adrian Carter and Duncan Mortimer – will begin the next stage of their careers at UQ in 2010.

Other early career researchers to assert their talent inside and outside UQ included Dr Mark Bellgrove, winner of the Paul Bourke Award for Early Career Researchers from the Academy of the Social Sciences in Australia and Dr Michael Piper, who received a Young Tall Poppy Science Award for Queensland from the Australian Institute of Policy and Science.

At another level, QBI's central role in the Australian Brain Bee Challenge has ignited interest in science amongst gifted high schoolers, all of whom show the potential for brilliant careers.

Consistent, institution-wide success is invariably a sign of committed leadership and excellent professional staff. I congratulate Perry and all staff and students on the accomplishments of this year, and thank them for contributing to UQ, the state and nation, and the global understanding of the human brain.



Professor Paul Greenfield AO
Vice-Chancellor

Image left: Professor Paul Greenfield, AO, Vice-Chancellor and President walking through UQ's Great Court.

Director's Report

In many ways it feels like only yesterday the Queensland Brain Institute became a reality.

What began as a handful of investigators in 2003 has grown into a dynamic neuroscience research facility with 26 outstanding principal investigators who are using a variety of models and approaches to understand the bases of brain function. I am delighted to see how the new collaborations between scientists facilitated through our move into the new QBI building in 2007 is resulting in new insights into how brain function is regulated, which, in turn, are leading to potentially novel therapies for a range of neurological and mental illnesses.

Amongst the advances highlighted in this year's report are the discovery by Daniel Blackmore and his colleagues that moderate exercise directly increases the number of stem cells in the ageing brain, a key finding if we are to uncover ways of regenerating the brain after injury or in later life; the identification by John McGrath and his team of a link between paternal age and an increased risk of schizophrenia and autism in children; the major advances in understanding how nerve fibres navigate being made by Geoffrey Goodhill's laboratory; and Mandyam Srinivasan's groundbreaking research into the fundamental mechanisms of the honeybee behaviour, which is providing fascinating insights into how vision, touch and motor control interact to control processes like landing and navigation.

Director's Report

I now look forward to even more significant discoveries in 2010, particularly in light of the leading new investigators who joined QBI in 2009: Professor Bryan Mowry an internationally renowned scientist in the field of the molecular genetics of schizophrenia; Associate Professor Stephen Williams from the University of Cambridge, who is currently establishing a synaptic plasticity laboratory; and Dr Timothy Bredy, from the University of California, Los Angeles, who will head the epigenomics laboratory. Despite only arriving in Australia in August, Tim has already heralded his potential with the awarding of an Australian Research Council Discovery Grant and a highly competitive Australian Research Fellowship.

While we were delighted to welcome these new arrivals, 2009 also saw the departure of Professor David Adams. In his position as Head of the University's School of Biomedical Sciences (SBMS) David was a staunch and generous supporter of QBI during its establishment phase, ultimately joining our Faculty when his tenure at the helm of SBMS came to an end. Not surprisingly, however, David's widely acknowledged leadership abilities soon led to his being recruited as Director of the new Health Innovations Research Institute at Melbourne's RMIT University. I would therefore like to take this opportunity to thank David, on behalf of all QBI, for his support over the years, and to wish him all the best in the challenges that lie ahead. I have no doubt that under his Directorship the Health Innovations Research Institute will quickly become a thriving hub of biomedical research.

I would also like to take this opportunity to congratulate Assoc. Professors Linda Richards and Geoffrey Goodhill, with late 2009 bringing news of their promotion to Professor, commencing January 2010. Linda and Geoff joined QBI in 2005, Linda from the University of Maryland and Geoff from Georgetown University, Washington DC. Since then they have both enjoyed outstanding funding success and have published numerous high impact papers. At the same time Geoff has dramatically raised the profile of computational neuroscience in Australia, running workshops that attract the best and brightest across a range of disciplines, including biology, mathematics and physics. Meanwhile Linda has been the founder and driving force behind the now flourishing Australian Brain Bee Challenge. Both have brought amazing passion and energy, not only to their personal research endeavours but also to mentoring and training the next generation of neuroscientists, and I offer them my thanks as well as my warmest congratulations.

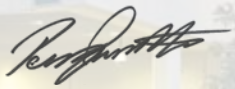
In addition to the efforts of our own Faculty, research in 2009 has been boosted by the contributions of a number of distinguished visitors. In November, we were privileged to host Professor Giacomo Rizzolatti for the inaugural Merson Lecture; his discovery of the 'mirror neurons' system has revolutionised our understanding of how we understand and mimic the actions of others. Another highlight was the Peter Goodenough Memorial Lecture in August, delivered by the internationally renowned psychiatrist, Professor Harvey Whiteford. The third of our named lectures for the year, the Toshiya Yamada Memorial Lecture was delivered by Professor Martyn Goulding from the Salk Institute, who I am delighted to announce has subsequently decided to join us as the recipient of an Australia Fellowship, the jewel in the crown of the National Health and Medical Research Council's Fellowship scheme. We were also privileged to have researchers from across the globe visit in September to discuss new advances in treating spinal cord injury at the Frontiers in Spinal Cord Research conference.

Collaboratively, I was especially delighted that the Institute signed agreements with key partner research facilities in China and India as part of our goal to establish joint laboratories to facilitate collaboration in both basic and clinical neuroscience. Joint workshops in both Beijing and Brisbane were held with the Institute of Biophysics, Chinese Academy of Sciences, culminating in the signing of a Letter of Agreement in August. It is anticipated that this will lead to the establishment of a joint laboratory in 2010. Formal research ties were also established with the famous Tata Institute for Fundamental Research in India, forging strong links in the area of depressive illness.

Overall, 2009 has been a productive and exciting year due to the hard work of a great many people – our Faculty, postdoctoral fellows, research assistants, and students, and our outstanding support staff. I am particularly grateful to my Deputy Directors for Research, Professor Pankaj Sah, and Operations, John Kelly, for their support and ongoing commitment to the success of the Institute.

Of course, our success would not be possible without the support of our many donors and benefactors and I thank them for their continued generosity. I am most grateful to the Development Board, chaired by David Merson, which has continued to provide me with support and advice. Of pivotal importance to the Institute is also the ongoing operational support provided by the Queensland State Government, which has enabled the Institute to perform at such a high level and to continue to recruit the best neuroscientists to QBI.

Finally, I wish to acknowledge Vice-Chancellor, Professor Paul Greenfield, Deputy Vice-Chancellor (Academic) Professor Debbie Terry and Deputy Vice-Chancellor (Research) Professor Max Lu for their continuing support, guidance and friendship.



Professor Perry Bartlett FAA
Director

Image left: QBI's Director Professor Perry Bartlett.

Development Board's Report

Development Board's Report

2009 saw the Development Board continuing to raise awareness of the Institute and promulgate the incredible research that is done by its ever-expanding cohort of world-renowned scientists.

While the Board often works behind the scenes – lobbying politicians, enhancing government relationships and building QBI's reputation – it also has a very public role. We were instrumental in enticing an unprecedented number of federal politicians to the Institute, largely to promote the proposal for a much-needed Centre for Ageing Dementia Research within QBI dedicated to the development of therapeutic approaches to treat ageing dementia. This condition is one of Australia's most significant health problems and directed research programs are vital if we are to maintain quality of life within our ageing society.

A submission has been made to the Federal Government asking it to provide $17.5m towards the $25m Centre, with the remainder of the funding being sought through philanthropy. An awareness campaign resulted in a number of politicians visiting the Institute to learn more about current dementia research and we are grateful for their support. The first six months saw many Queensland-based federal politicians tour the laboratories, including Ms Yvette D'Ath, Mr Graham Perrett, Mr Jon Sullivan and Senators Claire Moore, Mark Furner and John Hogg.

In July, Board member Sallyanne Atkinson joined QBI's Director Professor Perry Bartlett and a cohort of research staff to welcome Federal Minister for Health and Ageing, the Hon. Nicola Roxon MP to the Institute. The event also served as Brisbane City Councillor Milton Dick's first official function for the Institute, after he became a Board member in May 2009, although he was instrumental in coordinating the political visits in the first half of the year.

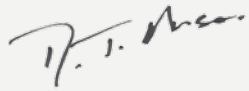
The final visit for 2009 was by the Federal Minister for Ageing, the Hon. Justine Elliot MP who, again with Sallyanne Atkinson, met with Professor Bartlett in mid-December followed by a tour of the laboratories and presentations by key researchers.

Further, Board member and Queensland Police Commissioner Bob Atkinson accompanied the state's Police Minister, the Hon. Neil Roberts MP on a tour of the Institute in November. This visit came on the back of another previous submission, this one to the State Government, applying for a percentage of revenue raised from fixed speed cameras to be used to further research into therapeutics for spinal injury patients.

Personally, this year has been momentous in my relations with the Institute. In November I was both privileged and honoured to attend the inaugural Merson Lecture presented by renowned neuroscientist Professor Giacomo Rizzolatti. In the years to come, I hope this lecture continues to provide the same depth of knowledge and provoke as much fascination in the human brain as the inaugural lecture did.

In December, Jeff Maclean's Index Group of Companies again sponsored the Ross Maclean Fellowship Race, as part of the Sunshine Coast Turf Club race program. As always, this event attracted a good crowd and it was pleasing to see a number of QBI staff turn out in support. Jeff also actively continued to promote fundraising activities throughout the year to raise funds for the Ross Maclean Fellowship, which supports research into motor neuron disease at QBI.

I thank my fellow Development Board members for their ongoing support and commitment to the Queensland Brain Institute, and to Perry Bartlett for his leadership and vision. I look forward to continuing to garner support for the much-needed Centre for Ageing Dementia Research in 2010.



David Merson
Chair, QBI Development Board

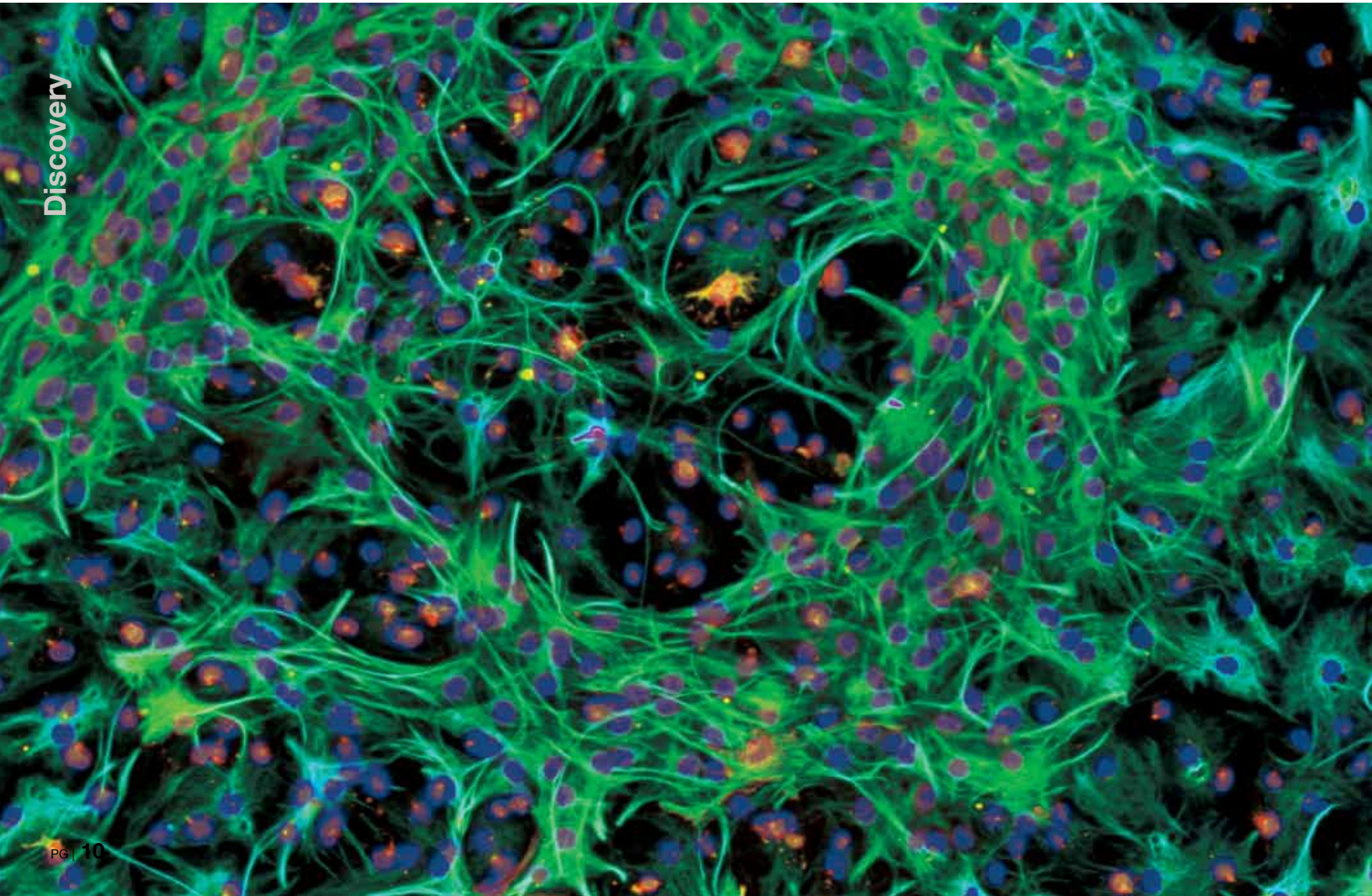
Images right, Board Members from left to right, top down: David Merson, Professor Paul Greenfield, Bob Atkinson, Mark Gray, Sallyanne Atkinson, John Lyons, Professor Perry Bartlett, Jeff Maclean, Milton Dick

Discovery

Discovery

In less than a decade the Queensland Brain Institute has cemented its reputation as a renowned neuroscience research facility. The Institute's scientists are constantly working to improve the lives of everyday Australians, through basic discovery, the development of targeted therapeutics and better informed public health messages.

In 2009 discoveries at the Queensland Brain Institute ranged from basic scientific findings through to life-changing treatments. With every new discovery came more evidence that the Institute's researchers are amongst the best in the world.



Healthy Body, **Healthy Mind**

If there was not already enough evidence that daily exercise is good for you, there is now further proof physical activity can help the brain.

Dr Daniel Blackmore is part of the research team that has shown physical exercise directly increases the number of stem cells in older animals.

"Our findings suggest that exercise, from early to late in life, can have a very positive effect. The brain's ability, even at an advanced age, to respond in a positive manner is very exciting," he said.

Stem cells are the body's building blocks. Endogenous neural stem cells within the brain are able to give rise to other cells, such as neurons, which then process and transmit information by electrochemical signalling.

Neuroscientists have known for some time that, in healthy brains, the creation of neurons continues throughout a person's life. However the number of new neurons declines with age. By increasing the formation of stem cells, it is hoped the production of neurons and other cells will also increase.

As such, scientists are now attempting to stimulate the production of stem cells in older brains and those damaged by Alzheimer's disease, ageing dementia, Huntington's disease and stroke.

"If we can activate stem cells later in life there's more of a chance we can tackle neurodegenerative disease. Investigating the mechanisms by which neural stem cell numbers are altered will undoubtedly increase our understanding of how the brain responds to its environment," Dr Blackmore said.

"Ultimately, this should allow us to discover how to harness the brain's regenerative capacity, and to bring about new and effective treatments for conditions caused by trauma, disease and even normal ageing."

The researchers monitored the number of stem cells in mice before and after they took part in exercise on a running wheel. They found the animals that voluntarily participated in exercise had a significantly higher number of stem cells than more sedentary mice.

Professor Michael Waters from UQ's Institute for Molecular Bioscience said: "The increase depended on the presence of the growth hormone, which sets final height, but declines with age.

"It evidently does the same in the brain, where it acts to regenerate neurons. Because growth hormone secretion is increased by moderate exercise, this reverses the decline in growth hormone seen in old age, increasing neural stem cell numbers," he said.

While the researchers predicted human trials were still a number of years off, they agreed the results were promising.

"Animal studies have shown that infusion of growth hormone into the brain increases stem cell numbers and the formation of new neurons," Professor Waters said.

Dr Blackmore added: "Showing we're able to increase stem cell numbers gives us great hope for therapeutic treatments in the future."

Dr Daniel Blackmore and Professor Michael Waters worked in collaboration with QBI's Drs Mohammad Golmohammadi and Rodney Rietze and Ms Beatrice Large. Their research paper *Exercise increases neural stem cell number in a GH-dependent manner, augmenting the regenerative response in aged mice* appeared in the online edition of *Stem Cells* in May and in print in August.

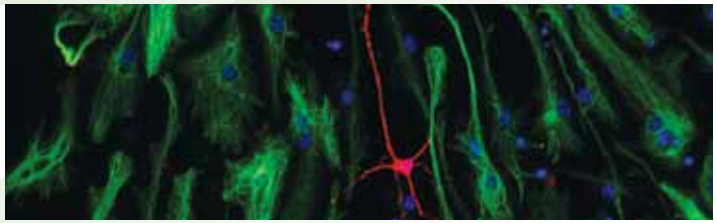


Image above: A neuron surrounded by astrocytes taken from a differentiated adult neurosphere.
Image left: Differentiated cells within an adult mouse (green – asrocytes, red – neurons, blue – nucleus).
Image right: Dr Daniel Blackmore at work in the laboratory.

Older, **not always Wiser**

Men have long believed age was on their side when it came to having children.

Now Queensland Brain Institute researchers have found males who postpone parenthood could be damaging their children's health, after they found a link between older paternal age and childhood IQ.

Professor John McGrath has previously identified a link between the age of a father and an increased chance of schizophrenia in his children. Evidence also suggests that later fatherhood is associated with an increased risk of autism in the offspring.

"These latest results were quite startling as it was thought that the age of the father was less of a concern compared to the age of the mother," Professor McGrath said.

"Now we are getting more evidence of the age of the father being just as important. The older a dad is, the worse his children tend to do in intelligence tests."

Fellow QBI researcher Claire Foldi said the findings could have "important implications for public health".

The researchers reanalysed data from one of the largest studies of children ever undertaken in the United States.

More than 33,000 children were tested at eight months, four years and seven years on a variety of intelligence tests and when Professor McGrath and his colleagues looked at the results against the age of the fathers a pattern soon became clear.

"Frankly, we were surprised to come up with such a clear-cut finding," Professor McGrath said.

"We are concerned that older men accumulate more mutations in the developing sperm cells. These mistakes can pile up and increase the risks of problems in the children, and it is possible that these mistakes will carry on into the next generation."

The next step for researchers is to establish the underlying factors that may explain the association between older fathers and child development. They are hoping mouse models will hold the key.

Ms Foldi said: "Animal experiments using genetically identical mice may provide the most effective means to determine genetic and epigenetic mechanisms.

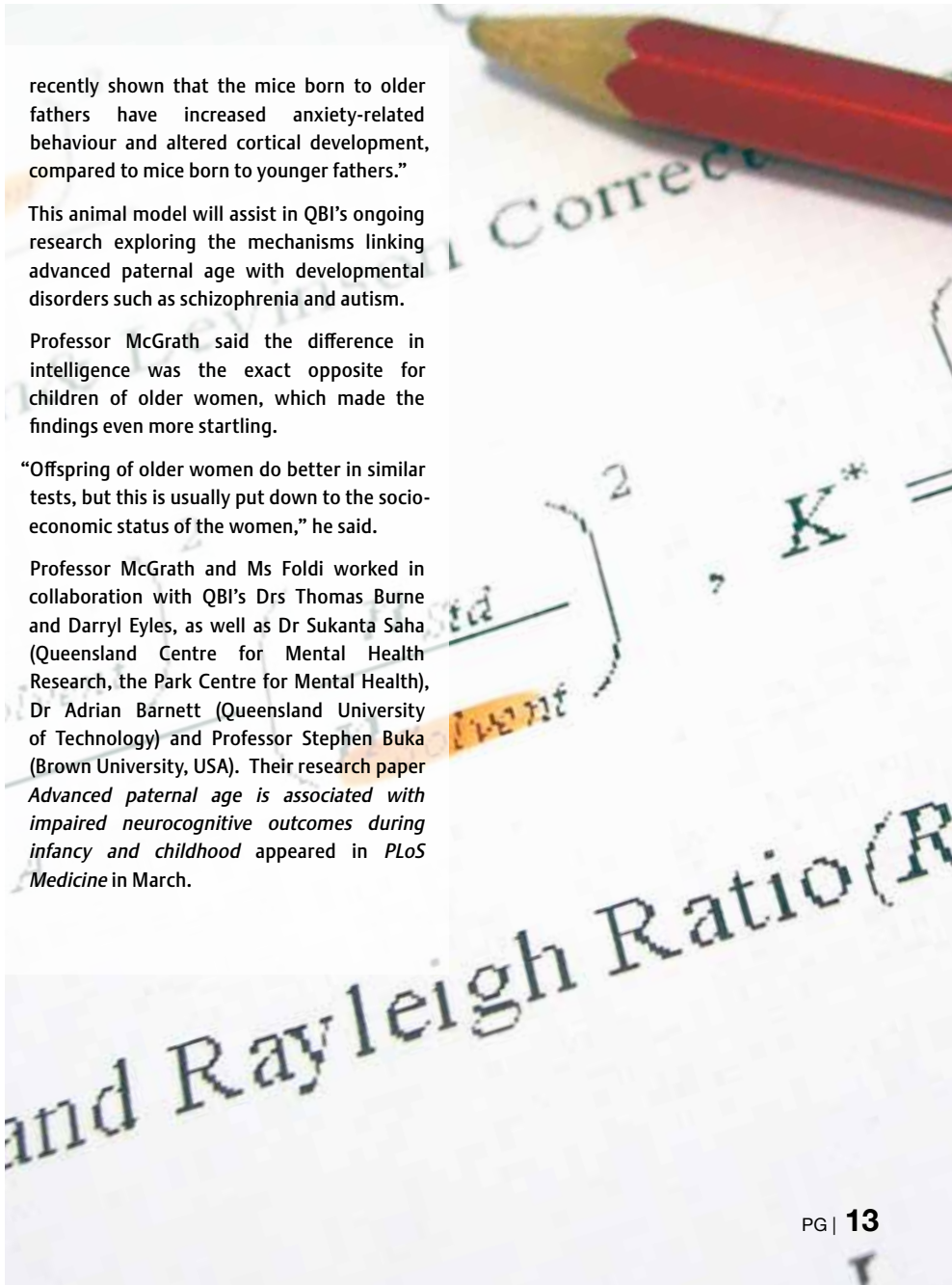
"However, it is important firstly to determine how the paternal age of the mice affects overall offspring development, including behaviour and brain morphology. We have recently shown that the mice born to older fathers have increased anxiety-related behaviour and altered cortical development, compared to mice born to younger fathers."

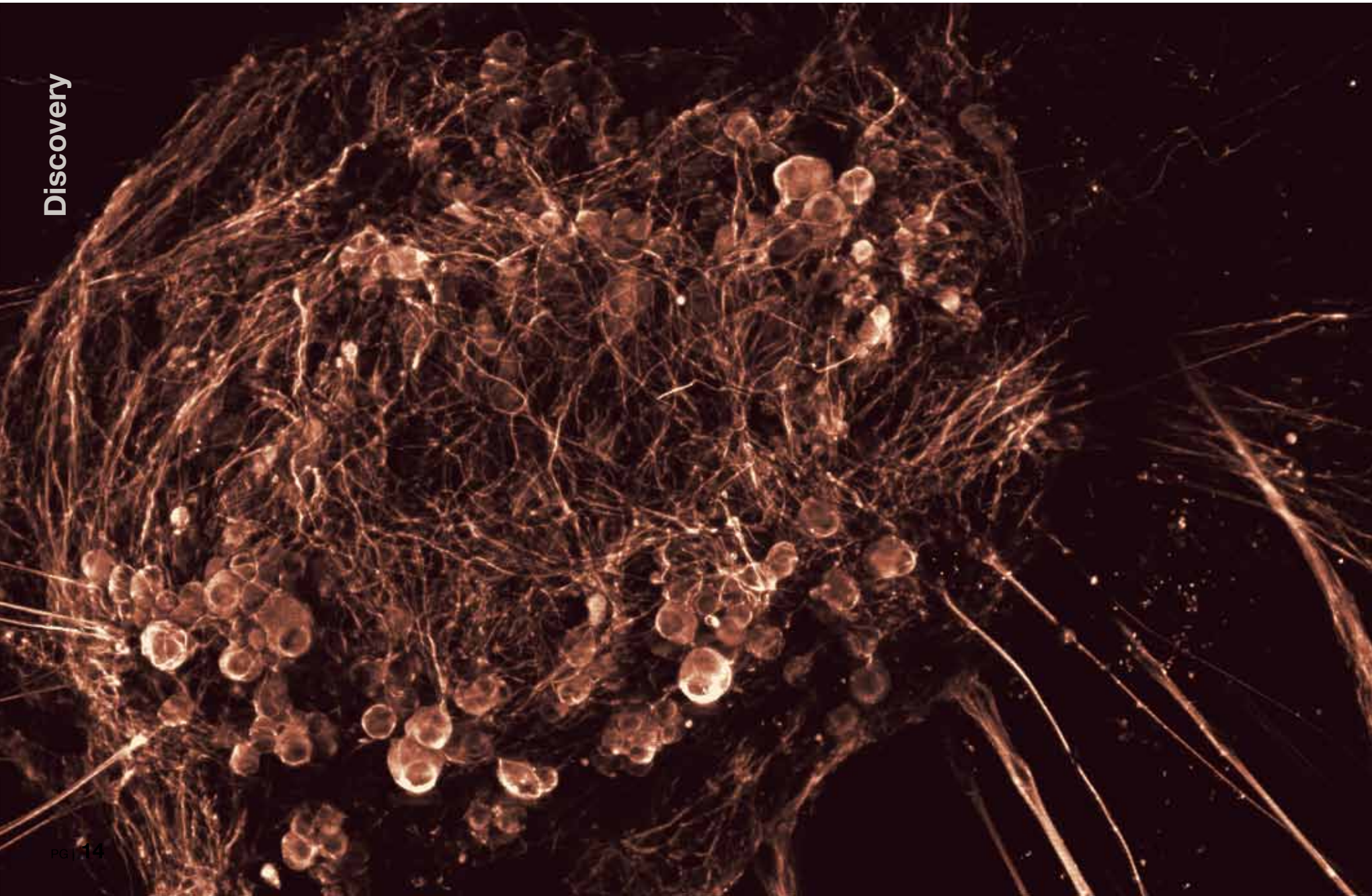
This animal model will assist in QBI's ongoing research exploring the mechanisms linking advanced paternal age with developmental disorders such as schizophrenia and autism.

Professor McGrath said the difference in intelligence was the exact opposite for children of older women, which made the findings even more startling.

"Offspring of older women do better in similar tests, but this is usually put down to the socio-economic status of the women," he said.

Professor McGrath and Ms Foldi worked in collaboration with QBI's Drs Thomas Burne and Darryl Eyles, as well as Dr Sukanta Saha (Queensland Centre for Mental Health Research, the Park Centre for Mental Health), Dr Adrian Barnett (Queensland University of Technology) and Professor Stephen Buka (Brown University, USA). Their research paper *Advanced paternal age is associated with impaired neurocognitive outcomes during infancy and childhood* appeared in *PLoS Medicine* in March.





Right Direction for **Brain Research**

Biology and mathematics are often intrinsically linked – never more so than when researchers are studying the innermost workings of the human brain.

In 2009 neuroscientists at the Queensland Brain Institute discovered a clever mathematical trick that allows them to quantitatively predict how nerve fibres behave. Nerve fibres – or axons – must make the right connections in the brain for it to function properly.

Using rat brains as animal models, the researchers carefully measured how the guidance of nerve fibres changed as the cues directing their growth varied. Scientists monitored the nerve fibres and, for the first time, were able to accurately predict how their guidance would change using a mathematical formula.

"The fibres are responding to local patterns of chemicals in their environment. If you 'zoom in' on the tip of a single growing nerve, these patterns can be described by the average background chemical concentration, and the direction and rate at which the concentration is changing," explained researcher and then PhD student Duncan Mortimer.

"Our model predicts how these parameters influence the behaviour of the growing fibre. For example, in our experiments, the nerves tend to grow towards higher concentrations of chemical, but their ability to estimate in which direction the concentration is increasing is controlled by the background concentration. Our model predicts how the background concentration affects the nerve fibres estimates."

Interestingly, the model researchers used assumed nerve fibres were making decisions in the cleverest possible way.

"This means that individual nerve fibres can be incredibly smart in the way they sift through information in their environment to decide where to grow," said Assoc. Professor Geoffrey Goodhill, who is the head of QBI's Computational Neuroscience laboratory.

He said these results could be important in informing research into how the brain is wired up during development. It could also assist in neuroregeneration after injury.

"Getting the wiring right is absolutely critical for brains to function properly," he said.

"The mathematical model now allows us to predict what will happen in any situation, not just the ones we've already measured."

Mr Mortimer added: "This could not only tell us about the way chemical signals that guide nerve fibres are arranged in normal nervous system development, but also might help us to understand what has gone wrong when nerves are not correctly guided."

In 2010, the team will continue this research and is now working on how nerve fibres turn their smart decisions into smart actions.

"Our data suggests that the best action to take may sometimes be a change in the growth rate of the nerve fibre rather than attempting to turn towards the gradient, which is surprising," Dr Goodhill said.

The research was carried out by QBI's Duncan Mortimer, Drs Julia Feldnera, Timothy Vaughan, Irina Vettera, Zac Pujic and William Rosoff, and Assoc. Professors Linda Richards and Geoffrey Goodhill, together with colleagues from The University of Queensland and University College London. The research paper *A Bayesian model predicts the response of axons to molecular gradients* appeared in the *Proceedings of the National Academy of Sciences* in June.

Image above: Assoc. Professor Geoffrey Goodhill. Image left: Nerve fibres emerge from cells in a dorsal root ganglion. Image right: The tip of a growing axon explores its environment to decide which way to grow.

Bees Show Off the **Perfect Landing**

Landing on a moving surface can be tricky at the best of times. Honeybees have the added complication of landing delicately while dealing with the elements – rain, wind and heat.

Scientists have devoted decades to studying how honeybees navigate their way around the landscape and in 2009 a team of Queensland Brain Institute researchers revealed how they perform the art of landing.

Unlike the 'controlled crash' of a fly landing, the bee lands with utmost care after 'reading' its airspeed visually, hovering above its landing ground and sensing it with vision, feelers and legs.

"As any trainee pilot knows, landing is one of the hardest things to do, as everything around you is changing so quickly," explains Professor Mandyam Srinivasan.

"It requires excellent coordination to get the speed, angle, distance and touchdown point exactly right – especially if, as in the case of the bee, the landing surface is sloping or even upside down."

The team used a special tiltable bee-landing platform and a high-speed camera to film the bees in the final moments of touchdown, and identify each of their separate actions.

On approach to their target the bees used optic flow (the stream of visual signals provided by their eyes as the landscape speeds past) until they found the perfect landing position.

From allowing biologists to travel to the depths of the ocean to enabling astronauts to travel further into space, researchers have identified an array of uses for these latest findings.

Already, neuroscientists are finding the results an invaluable tool for improving understanding of how the brain uses different senses simultaneously.

"In the field of neuroscience this work is providing new insights into how vision, touch and motor control are combined to orchestrate this critical manoeuvre flawlessly," Professor Srinivasan said.

"Figuring out how small insect brains process sensory information from the environment will help us understand how our own senses of vision, smell and touch work and how our brain uses sensory information to control our actions," added fellow researcher Dr Judith Reinhard.

Of particular interest to neuroscientists was the role of a honeybee's antennae in the landing process.

When the bees landed on surfaces ranging from vertical to upside down, their antennae came closest to the surface during the hover phase – now QBI researchers want to know why.

"We hadn't expected the antennae to play a role and it adds a further dimension to the 'instrumentation' the bee is using in order to achieve the perfect landing," says Professor Srinivasan, who has been studying honeybees for more than 20 years.

Further, the bee appears to use its visual system to correctly position its antennae, in order to 'read' the actual slope of the landing surface. This creates another puzzle for neuroscientists, who want to learn more about honeybee visual sensing, which could eventually inform research in humans.

The research was carried out by Ms Carla Evangelista, Drs Peter Kraft and Judith Reinhard and Professor Mandyam Srinivasan from QBI and Dr Marie Dacke from the University of Lund, Sweden. Their research paper, entitled *The moment before touchdown: landing manoeuvres of the honeybee* Apis mellifera, was published in the *Journal of Experimental Biology* in December.

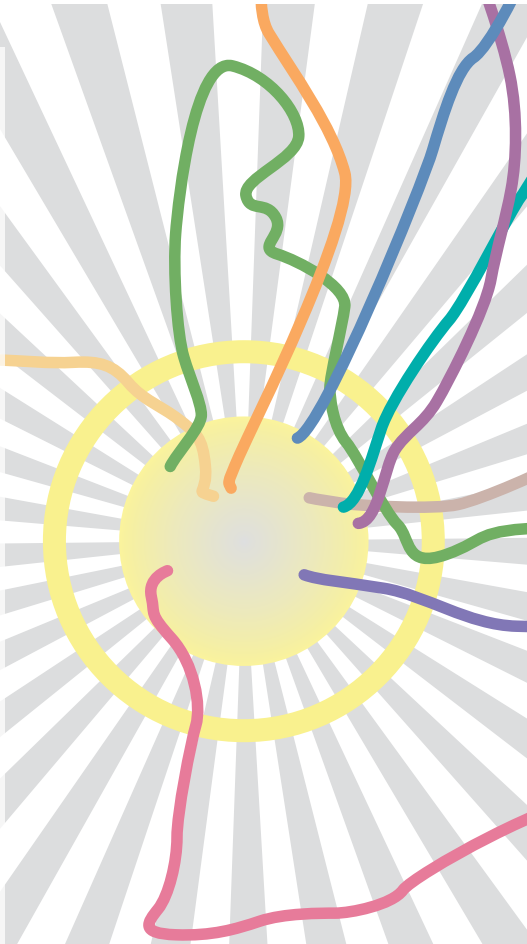
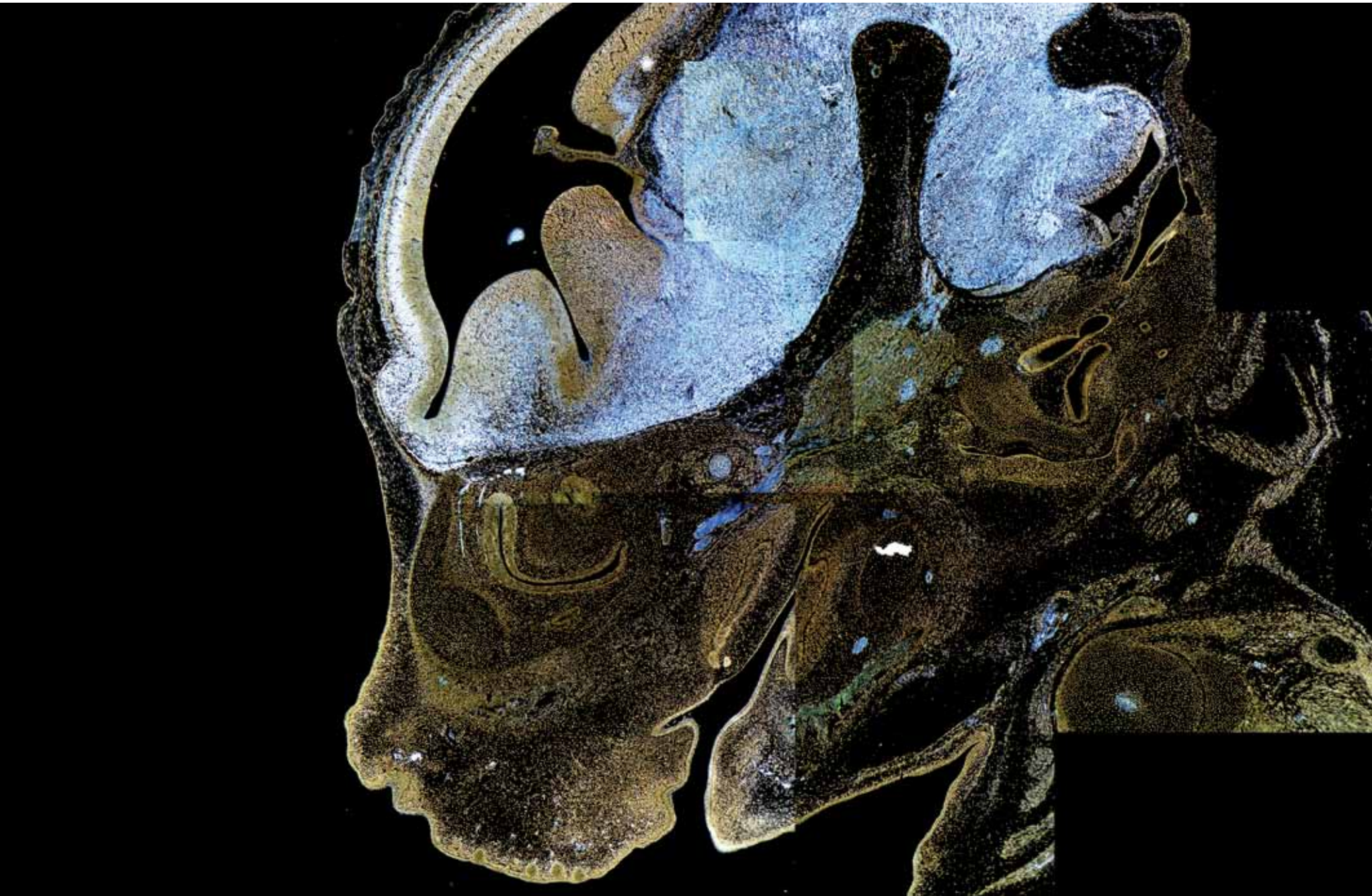


Image left: Professor Mandyam Srinivasan in QBI's all-weather bee facility. Image right: Honeybees are skilled at finding their landing targets.

Research

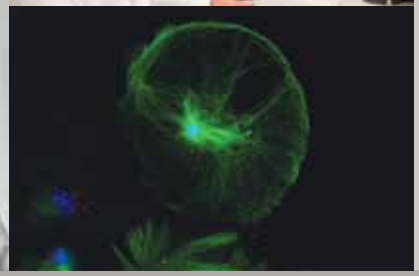


Research

At the Queensland Brain Institute there are more than 280 dedicated investigators working across eight research themes to uncover the fundamental mechanisms that regulate brain function. The scientists work under the guidance of 27 laboratory heads, all world-renowned researchers in their field.

Located in a state-of-the-art $63m facility, QBI neuroscientists utilise the world's most advanced investigative technologies for their research. They study a range of animal models including the mouse, honeybee, fruit fly, frog, zebrafish and flatworm.

Lab Head **Professor Perry Bartlett**



One of the most profound changes in the understanding of how brain function is regulated was the discovery by Professor Perry Bartlett's laboratory in 1992 that new nerve cells are produced in the adult brain by resident stem cells. *Subsequently, these new nerve cells have been implicated in regulating learning and memory, and stimulating their production may be therapeutic for diseases such as dementia and depression.*

In particular, researchers are studying how various factors released by nerve stimulation activate stem cells in the hippocampus to produce new nerve cells. To achieve this goal they are using unique cell-sorting technologies to isolate stem cells and novel in vivo *techniques to deplete or stimulate new nerve production.*

Image above: Dr Mark Spanevello and Sophie Tajouri examining spinal cord degeneration in the laboratory. Image below: Astrocyte (in green) from a differentiated neurosphere cultured from an aged brain.

Stimulating the production of new nerves

It is known that part of the brain called the hippocampus controls important types of learning and, increasingly, evidence suggests the production of new nerve cells in the region of the hippocampus known as the dentate gyrus is required for new memories to form. Ageing mice showing deficiencies in learning and memory also have decreased capacity to produce new nerve cells.

In 2008, the Bartlett laboratory discovered the stem cell in the hippocampus responsible for producing new nerve cells and showed that it was still present in the brain of older mice. Subsequently, the laboratory has uncovered several factors that regulate stem cell activation and can stimulate new nerve cell production. Researchers have found that stimulation of neural activity releases factors which activate stem cells and this may explain why animals which are placed in new environments, or exercise, also show an activation of stem cells. Recent work from the laboratory shows that exercise may release factors like growth hormone and prolactin that can directly activate stem cells in many brain regions.

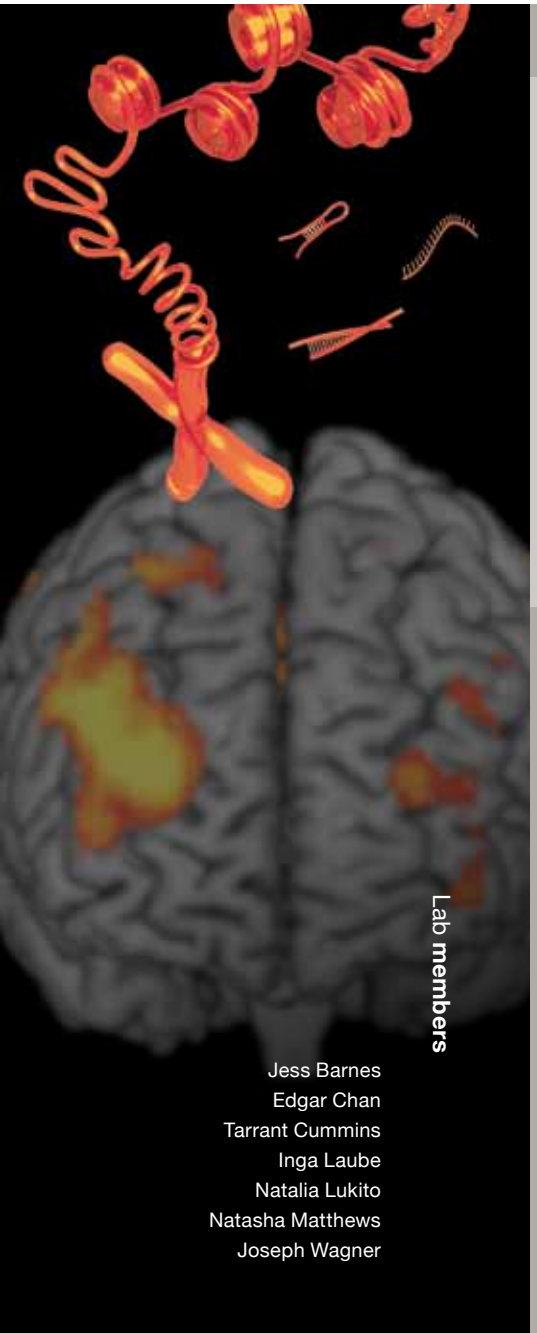
The group has also shown norepinephrine (NE) based antidepressants may directly stimulate stem cells to produce neurons. Of great interest is the recent finding that the stem cell population stimulated by NE is different from that stimulated by factors released during neural activity. This raises the possibility that nerve cells with different properties may be produced by varying stimuli and that this may regulate different learning activities. Thus, new therapeutics based on these different factors may be used to treat functional losses that occur in a variety of diseases.

Image right: Differentiated neurosphere cultured from an aged brain following exercise.

Lab **members**

Debra Black
Daniel Blackmore
Lavinia Codd
Xia Di
Dhanisha Jhaveri
Masahiro Kameda
Tamara Koudijs
Li Li
Eirinn Mackay
Estella Newcombe
Sumiti Saharan
Jay Spampanato
Mark Spanevello
Sophie Tajouri
Sandra Trojer
Jana Vukovic
Dianne Walker
Tara Walker

Lab Head **Assoc. Professor Mark Bellgrove**



Lab **members**

Jess Barnes
Edgar Chan
Tarrant Cummins
Inga Laube
Natalia Lukito
Natasha Matthews
Joseph Wagner

Humans have a unique ability to behave and think flexibly in an ever-changing social world. But how does the human brain enable such cognitive control and what are the factors that give rise to individual differences in such abilities?

Work in Assoc. Professor Mark Bellgrove's laboratory is addressing fundamental questions of cognitive science from a number of perspectives, including genetics and pharmacology. This work has direct implications for conditions such as attention deficit hyperactivity disorder (ADHD) and the group is actively engaged in international research efforts to identify risk genes for the condition.

Image below: Functional magnetic resonance image showing brain areas activated during cognitive control.

Finding the genetic mechanisms of ADHD

Attention deficit hyperactivity disorder is a common and controversial condition, most prevalent in children. Scientists now know that the disorder is heritable, meaning that it runs in families.

An excellent candidate gene for ADHD is the dopamine transporter gene (DAT1). Drugs, such as Ritalin, which are used to treat ADHD, act on the dopamine transporter to make more of a chemical known as dopamine available for signalling messages in the brain. Although a large number of international studies have now confirmed DAT1 as a risk gene for ADHD, how variation in this gene might give rise to differences in behaviour has previously been unknown.

Researchers in the Bellgrove laboratory are now conducting one of the largest ever Australian studies into the disorder. They have been asking children with and without ADHD to perform detailed cognitive assessments and have discovered that DNA variation in the DAT1 gene has an important influence on the attention of children. Specifically, variation in this gene influenced the degree to which attention was caught by sudden-onset or distracting stimuli. Although the effect of the gene was present in children both with and without ADHD, the effect was magnified in children with the condition who carried the DAT1 risk gene.

This confirms the gene might confer risk to ADHD, in part through its influence on the development of attention networks in the brain, including the frontal and parietal cortices. Work in the Bellgrove laboratory is now testing these additional hypotheses.

Image left: Understanding DNA and chromosomes is vital to understanding ADHD.

Lab Head **Assoc. Professor Ross Cunnington**

Research in Assoc. Professor Ross Cunnington's laboratory focuses on the brain processes involved in planning and preparing for voluntary actions, and for perceiving and understanding the actions of others.

Whenever we plan, imagine or observe others performing actions, representations of those actions are encoded in the motor areas of the brain.

Cunnington laboratory researchers use imaging methods to examine how the brain forms its action plan before initiating voluntary movement and how our own plans for action can influence the way we perceive the movements of others.

Images above: Researchers prepare patients for a series of imaging tests.

Unravelling the mirror neuron system

The Cunnington laboratory examines the human 'mirror neuron' system, a part of the brain that is important in allowing us to perceive and understand the actions of others. It is thought that people understand others' actions by directly simulating or mirroring those movements in their own mind. This is what underlies human abilities such as empathy, understanding, social development and learning.

It is well known that watching others' actions affects our own movements – we often unconsciously copy the body positions or hand gestures of people around us or change our walking pattern to match others. Now the Cunnington laboratory has discovered that our individual actions also influence the way we see – or perceive – the actions of others.

Group researchers have shown that when people plan to perform a particular action, the motor plans for that action influence the way observed actions are processed in the brain. This shows that the motor system of the brain (typically considered the output side of the brain for controlling movement) actually plays a role in the way we perceive and understand others' actions.

Further, it has been revealed that the way individuals perceive others' actions is also influenced by group or team biases. Most sports fans know the feeling of 'bad' refereeing decisions that go against members of their own team – this research found areas of the brain important for the visual perception of actions actually respond differently to actions of one's own team members compared with those of opponents. This suggests support for our team really is in the brain.

Image right: Brain activation during the imitation of observed hand actions.

Lab **members**

Katharine Baker
Marta Bortoletto
Veronika Halasz
Sashenka Milston
Pascal Molenberghs
Kian Ng
Vinh Nguyen

Lab Head **Professor Jason Mattingley**

Lab **members**

Oliver Baumann
Edgar Chan
Michael Dwyer
Ranmalee Eramudugolla
Will Harrison
Oscar Jacoby
Marc Kamke
David Lloyd
Pascal Molenberghs
David Painter
Amanda Robinson
Martin Sale
Ashley Skilleter

One of the greatest challenges faced by all animal brains is filtering and prioritising the tide of incoming sensory information in order to guide adaptive behaviour. Such filtering processes are controlled by mechanisms of attention.

Research in Professor Jason Mattingley's laboratory focuses on how attention influences basic perceptual, cognitive and motor processes in both healthy individuals and in people with neurological and psychiatric disorders, including stroke, dementia and attention deficit hyperactivity disorder (ADHD). To achieve these goals, the team uses cutting-edge brain imaging and brain stimulation techniques, including functional magnetic resonance imaging (fMRI), electroencephalography (EEG) and transcranial magnetic stimulation (TMS).

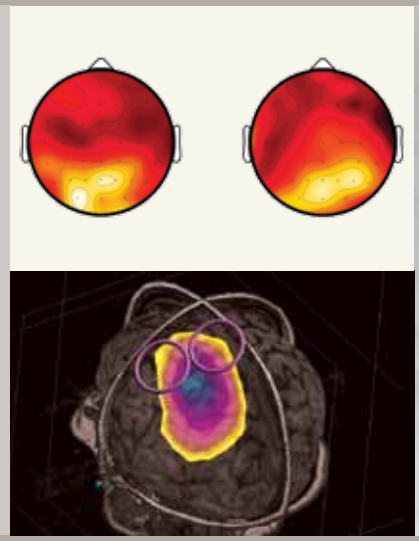


Image above: EEG map of brain activity during an attention task. Image below: TMS hotspot on brain surface.

Understanding attention in health and disease

Attentional processes can be catastrophically affected by cerebral stroke, which is caused by rupture or blockage of blood vessels in the brain. Some stroke patients exhibit a syndrome called 'spatial neglect', in which half the world 'disappears' from awareness. For patients whose stroke has affected the right hemisphere of the brain, their neglect will cause them to ignore food on the left side of the plate, bump into objects on their left and omit words from the left side of the page while reading. Currently there is no effective medical treatment for the condition.

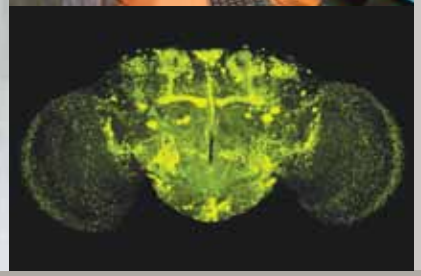
In 2009 researchers in the Mattingley laboratory tested the efficacy of a new technique for treating spatial neglect after stroke. They found that having patients adapt to optical wedge prisms reduced or eliminated many of the visual and auditory impairments that characterise neglect. The challenge now for scientists is to understand the brain processes underpinning these dramatic therapeutic effects.

Mechanisms of attention also play a key role in learning and brain plasticity, which in turn are crucial for function recovery after brain damage. Studies conducted by researchers in the Mattingley group used TMS – a brain stimulation technique – to examine plasticity and learning-related changes in the human primary motor cortex, a part of the brain that controls voluntary limb movements.

The next step for the neuroscientists is to discover how mechanisms of attention regulate plasticity in the primary motor cortex. Armed with this knowledge, researchers will be able to develop more effective approaches for the rehabilitation of sensory and motor impairments following stroke.

Image left: Using TMS to examine attention processes in the human brain.

Lab Head **Assoc. Professor Bruno van Swinderen**



Assoc. Professor Bruno van Swinderen's laboratory uses the fruit fly model* Drosophila melanogaster *to investigate perception and cognition.

By combining powerful molecular genetic tools with high throughput behavioural testing and electrophysiology, the group is able to study the foundations of complex phenomena such as selective attention, memory, general anaesthesia and sleep in the simple fly brain. Eventually the laboratory will apply its findings to the human 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 for the laboratory, with a focus on visual systems.

Image above: Oliver Evans at work in the laboratory. Image below: GFP labelling of fly memory circuits involved in learning and memory.

Investigating mechanisms of visual attention

Memory and attention are intertwined. However, *Drosophila* research investigating learning and memory over the past two decades has rarely considered attention-like processes when unravelling the molecular and cellular pathways to memory formation.

Building on previous results showing that classical short-term memory mutants also have attention-like defects, the van Swinderen laboratory recently demonstrated that long-term memory mutants are similarly defective for attention-like phenotypes. A behavioural screen uncovered several strains with visual attention defects, a finding that was confirmed by recording brain activity from individual mutant flies. This study suggested that overlapping structures in the fly brain are modulating both attention and memory formation, thereby pointing to the neuroanatomy where these processes are likely to interact in order to control behaviour. The expression of a memory gene during late stages of fly brain development was found to be crucial for optimal attention-like behaviour in the adult.

Silencing neuronal output from structures associated with memory formation (eg the mushroom bodies) was found to compromise attention-like processes: flies were less able to suppress visual responses behaviourally and this was associated with decreased 20-30Hz activity in the fly brain. These results suggest neurons in the fly brain that have been associated with memory formation are also involved in generating patterns of brain activity that are required for selective attention. The next step is to exploit these common circuits and genes to unravel how memory and attention interact in the *Drosophila* brain.

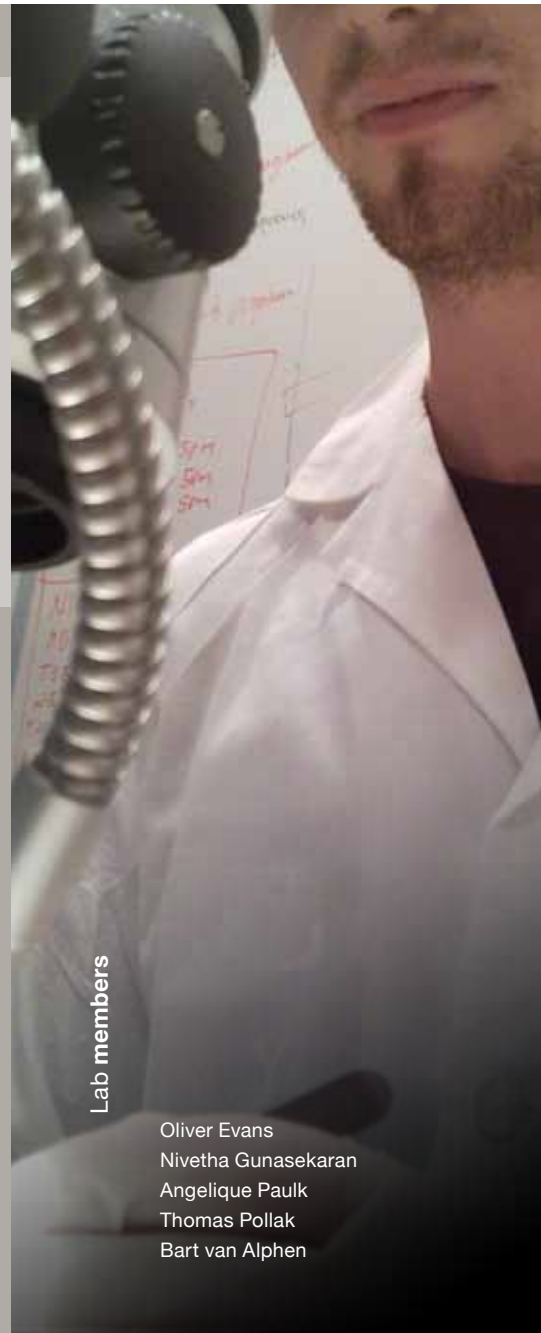


Image right: Thomas Pollak in the laboratory.

Lab **members**

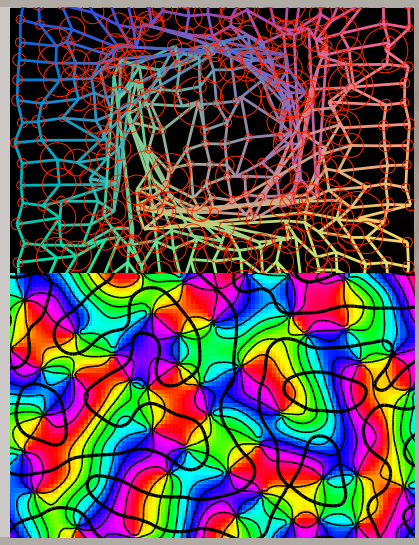
Oliver Evans
Nivetha Gunasekaran
Angelique Paulk
Thomas Pollak
Bart van Alphen

Lab Head **Assoc. Professor Geoffrey Goodhill**

For the brain to function properly its neurons must be connected correctly – wiring defects underlie a number of nervous system disorders.

Research in Assoc. Professor Geoffrey Goodhill's laboratory uses a unique combination of experiments and theoretical modelling to develop a computational understanding of how the nervous system becomes wired up during development. The laboratory's guiding philosophy is that building mathematical models allows a much more precise understanding of the underlying phenomena than relying on purely qualitative reasoning.*

Using an interdisciplinary approach attracts students and postdoctoratoral researchers with backgrounds ranging from physics and mathematics, to neuroscience and medicine.



All images: Computer simulations of visual map formation help the laboratory understand the biological rules that guide visual development.

Computational mechanisms of brain development

An area of focus for the Goodhill laboratory is how nerve fibres (axons) are guided by molecular gradients to find appropriate targets in the developing nervous system. Recently, the group has found the response of axons to shallow gradients is different from their response to steep gradients – qualitatively and quantitatively. This helps explain apparent anomalies between results from different gradient assays and also provides an insight into the way axons are affected by gradients *in vivo.*

The laboratory has also investigated the form and shape of growth cones (the structures at the tip of developing axons). This morphology is complex and highly dynamic but the significance of these changes for the sensory and motor roles of growth cones is mostly unknown. As such, sophisticated mathematical techniques for characterising shape in general are being adapted in order to develop a more quantitative understanding of the role that growth cone shape plays in effective axon guidance.

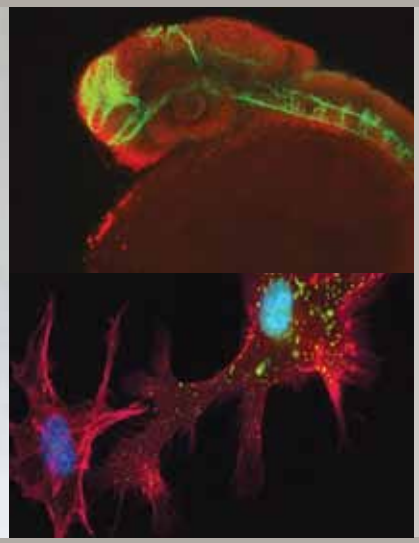
Further, the Goodhill laboratory is studying visual system development, particularly maps in the primary visual cortex. Visual maps (and thus visual function) are affected by the statistics of visual input during early life, but teasing apart the relative contributions of input-dependent mechanisms of development has proved an extremely challenging task. Researchers have investigated the effect of restricting visual input early in life on visual development. Their theoretical predictions suggest that a surprisingly greater degree of visual map structure plasticity may be possible – a theory that is being tested by experimental collaborators.

* Promoted to Professor, effective 01 January 2010.

Lab members

Stanley Chan
Clare Giacomantonio
Carmen Haines
Jonathan Hunt
Robert Kerr
Duncan Mortimer
Zac Pujic
Hugh Simpson
Andrew Thompson
Jiajia Yuan

Lab Head **Assoc. Professor Helen Cooper**



Neural stem cell activity, cell migration and axon guidance establish the complex architecture of the brain. *Failure of these processes results in neural tube defects, epilepsy and mental retardation. Assoc. Professor Helen Cooper's laboratory investigates how specialised cell surface receptors regulate these functions during development and in the generation of neurons in the adult brain.*

Presently there are no effective therapies to combat conditions such as Alzheimer's and Huntington's disease. While some bioactive molecules have shown promise as effective therapies, failure to deliver these drugs into the brain has limited their clinical development. The Nano-Neuro Project is developing nanoparticles as drug delivery systems for the treatment of neurodegenerative disease.

Image above: Zebrafish showing axon tracts. Image below: Stuctural element of the neuron (red) in a developing mouse embryo.

Investigating cell surface receptor function

The Cooper laboratory's recent studies have demonstrated that neogenin receptor loss severely perturbs neural tube formation in zebrafish, leading to a dramatic loss of neuronal populations. Researchers understand that these defects result from a failure of cell-cell contact, leading to the collapse of the cellular architecture of the stem cell compartment. The group is now investigating molecular mechanisms regulating neogenin function in the mouse brain.

The group has also found neogenin in neurogenic zones of the adult mouse forebrain where it is expressed by neural stem cells and newborn neurons. This receptor is present on the same populations in the adult human forebrain, indicating that its function is conserved in humans.

In another study, the laboratory has shown that the Ryk axon guidance receptor is responsible for the guidance of axons across the largest commissure in the mammalian brain (the corpus callosum) and into the contralateral hemisphere. Diffusion tensor magnetic resonance imaging has revealed that Ryk is important for the formation of many other forebrain axon tracts, including the fornix and internal capsule.

The Nano-Neuro Project is a collaboration between QBI, UQ's Australian Institute for Bioengineering and Nanotechnology and China's Fudan University. It has demonstrated for the first time that a new type of nanoparticles can efficiently deliver small interfering ribonucleic acids (RNAs) to neurons and has found internalisation of the nanoparticle-drug complex is rapid and effectively silences neuronal gene expression.

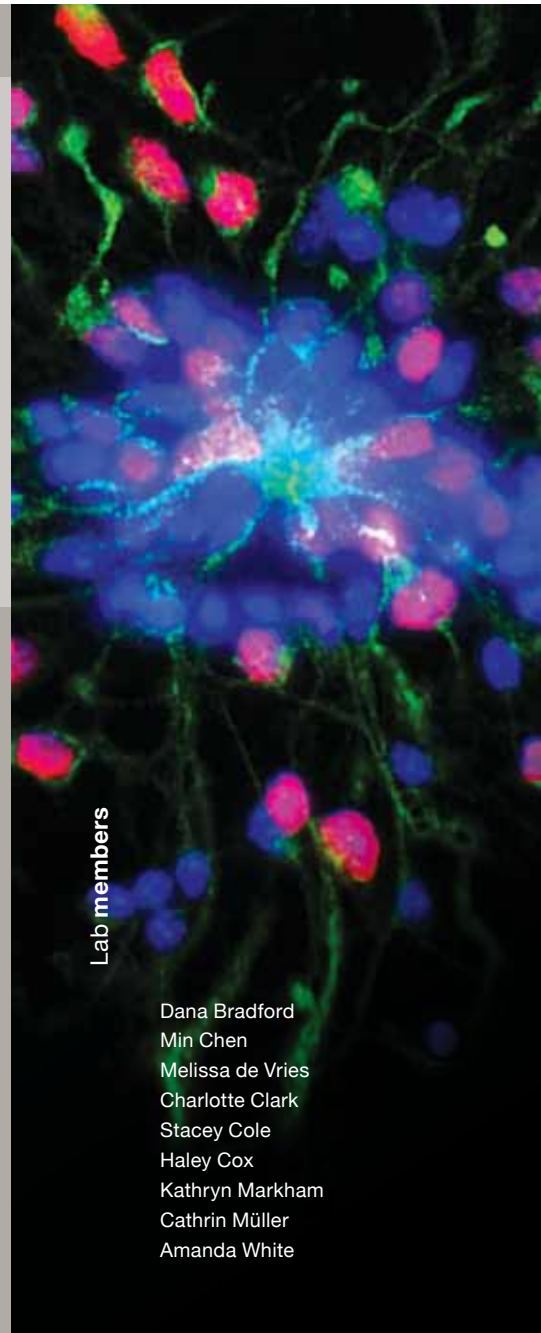
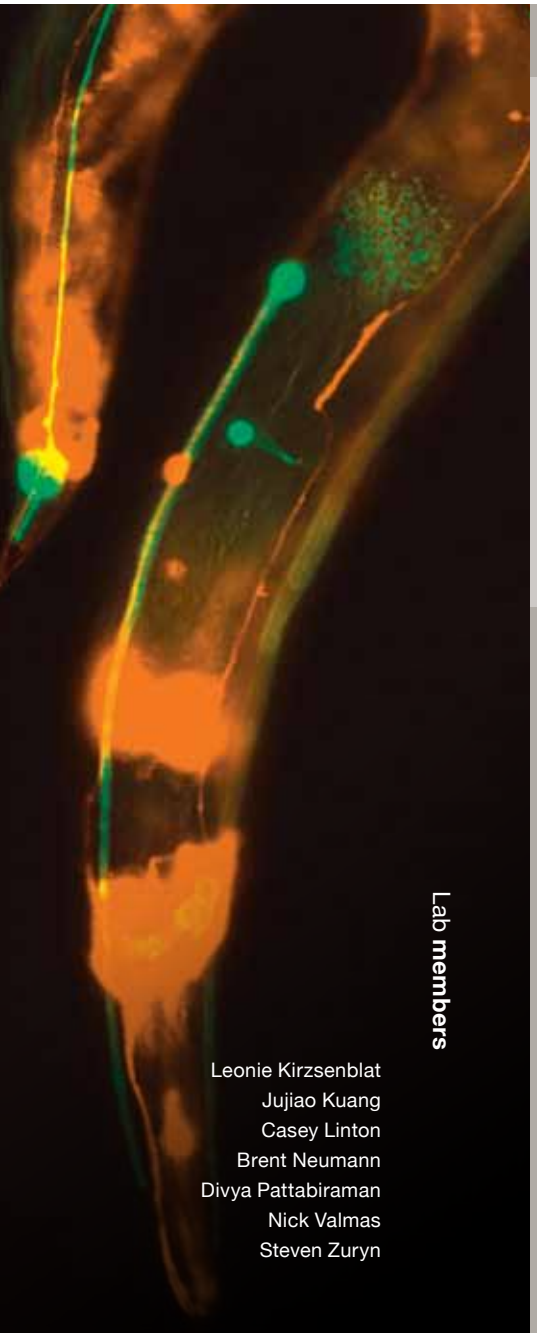


Image right: Adult neural stem cells (blue) begin to produce neurons (pink and green).

Lab **members**

Dana Bradford
Min Chen
Melissa de Vries
Charlotte Clark
Stacey Cole
Haley Cox
Kathryn Markham
Cathrin Müller
Amanda White

Lab Head **Dr Massimo Hilliard**



Lab **members**

Leonie Kirzsenblat
Jujiao Kuang
Casey Linton
Brent Neumann
Divya Pattabiraman
Nick Valmas
Steven Zuryn

Determining how individual neurons develop is crucial for understanding how highly complex neuronal structures, such as the brain and spinal cord, are formed. *Dr Massimo Hilliard's laboratory is interested in understanding how axons (nerve fibres conducting impulses from the neuron) and dendrites (nerve processes conducting impulses to the neuron) develop and how they are guided to their targets. The group also investigates how axonal structure is maintained over time and how it can be reconstituted after injury.*

A combination of genetics, molecular biology and imaging techniques are routinely employed to tackle these neurodevelopmental questions. The nematode – or roundworm – Caenorhabditis elegans *is the experimental animal model system used.*

Developmental Neurobiology

Image above: A coiled larval stage *C. elegans* worm. Image below: *C. elegans* expressing green fluorescent protein in oxygen sensory neurons.

Investigating neuronal growth, damage and repair

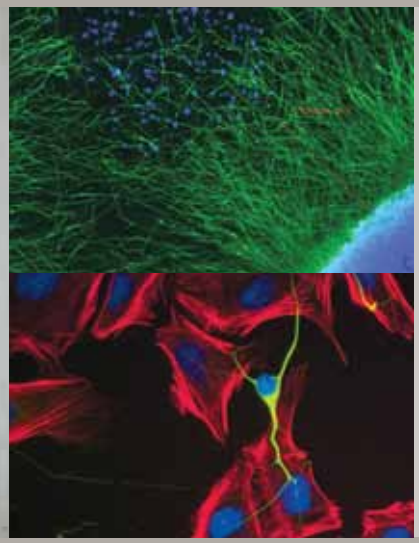
Neurons are among the most highly polarised cells in the body, with their dendrites and axons forming distinct morphological and functional domains. However, the understanding of how dendrites develop is poor, with only a few molecules known to play a role in this process. Using a *C. elegans* oxygen sensory neuron as a model system, the Hilliard group has identified two Wnt ligands and two Frizzled receptors that regulate dendrite development *in vivo*.

The axon protruding from a neuronal cell can extend extraordinarily long distances, in some cases reaching almost the full length of an animal's body. As such, mechanisms are in place to maintain the structural integrity of these long processes over the lifetime of the animal. Using a forward genetic screen, researchers in the Hilliard group have identified mutant animals in which the axons of a subset of *C. elegans* mechanosensory neurons spontaneously degenerate. The group is now working to identify the mutated genes responsible for this degenerative condition.

A crucial question for neurobiologists is how some axons can regenerate following nerve damage while others cannot. The answer will be of great value for the treatment of neurodegenerative diseases and traumatic nerve injuries. Using a newly developed laser-based technology allowing axotomy of single neurons in living *C. elegans* animals, the Hilliard laboratory has characterised axonal regeneration in different classes of sensory neurons. A candidate gene approach has revealed some important molecules necessary for successful regeneration, and this research will continue in 2010.

Image left: An adult *C. elegans* with different subsets of neurons stained green and orange.

Lab Head **Assoc. Professor Linda Richards**



Researchers in Assoc. Professor Linda Richards'* laboratory investigate how the brain develops prior to birth. *The proper formation of the brain and the connections formed between neurons in different areas is essential to brain function in children and adults.*

The laboratory is focused on understanding the mechanisms regulating the formation of the cerebral cortex and the corpus callosum, which connects the left and right sides of the brain and is involved in higher-order cognitive processes. These processes include sensory and motor information processing as well as speech, emotions, memory formation and storage, and many other brain functions. The focus of the Richards group is to understand how cerebral cortex cells are generated and how they make functional connections.

Image above: Nerve fibres (green) growing from an explant of developing mouse cerebral cortical tissue *in vitro*. Image below: Glia are important for the guidance of nerve fibres. Shown are neurons (green) growing on a glial monolayer (red).

Forming connections in the developing brain

Neuroscientists in the Richards laboratory have made excellent progress in three major areas of research during 2009 – the development of the cortical midline and the commissural plate, mechanisms of axon guidance at the cortical midline and formation of the corpus callosum, and the development of the cerebral cortex and its regulation by the nuclear factor one gene (Nfi) family.

The researchers have demonstrated the role of the secreted Semaphorin proteins and their receptor, Neuropilin, in the formation of the corpus callosum. The group has also shown that multiple deficits are present in mice with mutations in Nfib, which may explain why the corpus callosum does not develop properly during embryonic growth.

In collaborative studies, new roles were discovered for the Nfi genes in the formation of hindbrain structures, such as the basilar pons, and other hindbrain nuclei important for the control and coordination of movement. Using magnetic resonance imaging, the group also contributed to studies on the development of the human fetal brain through research into the development of axonal fibre projections.

In another line of investigation, an in-house collaboration with Assoc. Professor Geoffrey Goodhill's laboratory demonstrated how Bayesian modelling could be applied to better understanding axonal chemotaxis (when chemicals direct cell movement).

The group also published a review for paediatric neurologists on the mechanisms regulating corpus callosum formation and a commentary on neurobiology, epidemiology and schizophrenia with QBI's Professor John McGrath.

Image right: Hippocampal nerve fibres (green) and nerve fibres of the corpus callosum (red) form bundles that mis-project in Robo1 knockout mice.

*Promoted to Professor, effective 01 January 2010.

Lab **members**

John Baisden
Guy Barry
Sean Coakley
Amber-Lee Donahoo
Ilan Gobius
Katelin Haynes
Erica Little
Sha (Samantha) Liu
Sharon Mason
Randal Moldrich
Michael Piper
Janet Thurley
Divya Unni
Oressia Zaluki

Lab Head **Dr Timothy Bredy**

Dr Timothy Bredy's laboratory is interested in elucidating how the genome is connected to the environment and how this relationship shapes brain and behaviour across the lifespan.

In contrast to the information conveyed by a static genome, the epigenome is very dynamic and can be modified by exposure to a variety of environmental stimuli, including learning, exposure to drugs of abuse, environmental toxins, dietary factors and social interaction.

The group is exploring the hypothesis that epigenetic mechanisms serve an important role as the interface between environmental signals, genomic responses and adaptive behaviour, and that they make a major contribution to memory and to the development of psychiatric disorders.

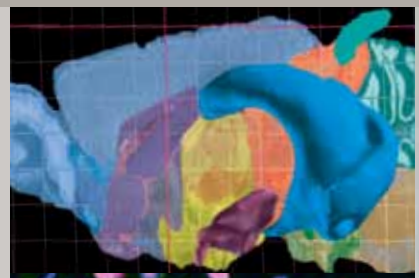


Image above: Brain regions supporting the acquisition and extinction of conditioned fear. Image below: Infralimbic neurons co-labelled with Tbr1, a marker of pyramidal neurons and RCS (regulator of calmodulin signalling).

Molecular basis of learning and memory

2009 has been a year of transition for the laboratory. It was established in August when Dr Bredy moved from the University of California, Los Angeles and since then staff have been busy outfitting the space with equipment for studies in behavioural, cellular and molecular neuroscience.

Shortly after the group began, the Bredy laboratory secured a five-year ARC Discovery Grant examining epigenetic mechanisms of sex differences in fear-related learning. Building on previous findings that women are two to four times more likely to suffer fear-related anxiety disorders, this study will determine how differences between male and female brains contribute to the formation and maintenance of long-term fear memories. Combined with the recruitment of two excellent research assistants, Drs Carlos Coelho and Wei Wei, it is hoped the group's research will lead to improved therapeutic gender-specific remedies.

In 2010 researchers in the laboratory will also be heavily involved in a number of major collaborations. They will work with scientists at The University of Queensland's Institute for Molecular Bioscience to establish the role of non-coding ribonucleic acid (RNA) and RNA editing in learning and memory.

Further, the group will undertake two projects with investigators from the Florey Neuroscience Institutes examining common epigenetic mechanisms in anxiety disorders and addiction, and the long-term epigenetic effects of inhalant abuse on drug-seeking behaviour.

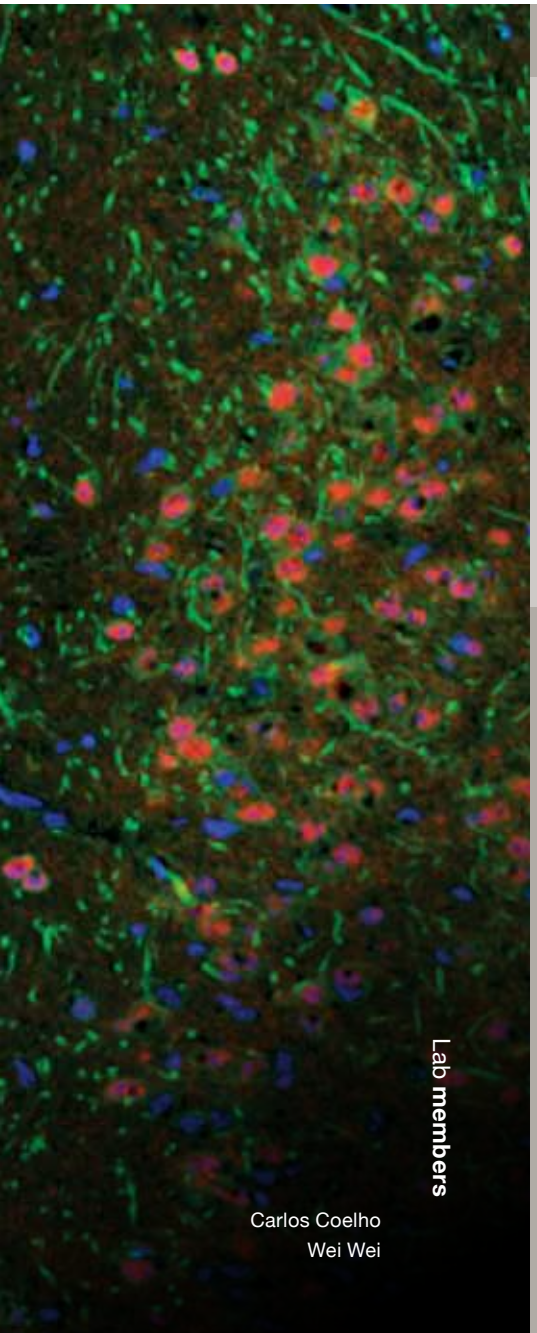
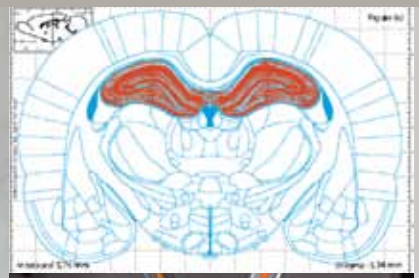


Image left: Inframbic neurons co-labelled with PCAF and CBP, two histone acetyltransferases.

Lab members

Carlos Coelho
Wei Wei

Lab Head **Dr Thomas Burne**



Dr Thomas Burne's laboratory studies brain development and behaviour in animal models to learn more about neuropsychiatric diseases, such as schizophrenia.

Research is focused 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 (DVD) deficiency on brain development, the impact of adult vitamin D deficiency on brain function and behaviour and, more recently, the neurobiological effects of having an older father.

The group is also part of the Queensland Centre for Mental Health Research.

Image above: Brain section showing hippocampus. Image below: Rat path through 8 arm radial maze.

Finding the causes of mental illness

In 2009 the Burne laboratory, in collaboration with QBI's Dr Darryl Eyles and Professor John McGrath, built on its previous research showing that low prenatal vitamin D (the 'sunshine hormone') is associated with altered brain development. There have been a range of studies exploring the behaviour, brain neurochemistry and receptor profile associated with vitamin D deficiency in animal models. Now the collaboration is investigating the impact of DVD deficiency on social and cognitive behaviours. Research into the impact of adult vitamin D deficiency on brain function has also started.

The Burne group has also expanded its research tools, with a challenging cognitive behavioural test called the Five Choice Continuous Performance Task, which assesses attentional processing in rodents. The goal now is to investigate the neurobiology of altered cognition in animal models, by looking at selected cognitive domains – sensorimotor gating, working memory, attention and speed of processing, learning and memory, and problem solving – that are known to be disrupted in schizophrenia. In collaboration with Assoc. Professor Bruno van Swinderen and Professor Jason Mattingley, researcher Dr Bart van Alphen has explored aspects of sensorimotor gating and attentional function in the fly.

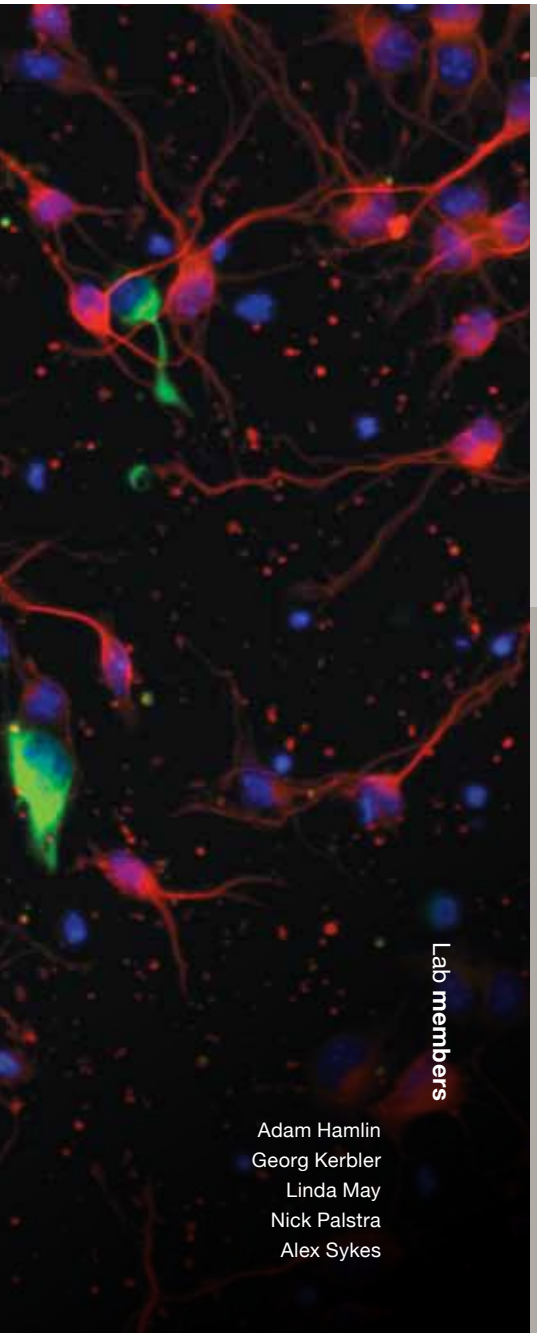
Further, in 2009 the group published the first comprehensive study of the impact of advanced paternal age in a mouse model on behaviour and brain structure. In collaboration with researchers at the Queensland Institute of Medical Research, explorations into behavioural, genomic and brain imaging in a mouse model are now underway.

Lab **members**

Suzanne Alexander
Eamon Byrne
Jacqueline Byrne
Luke Carrol
Xiaoying Cui
Carlie Cullen
Trudi Flatscher-Bader
Claire Foldi
Isabelle Formella
Lauren Harms
James Kesby
Pauline Ko
Matt Pelekanos
Karthik Purushothaman
Henry Simila
Karly Turner
Bart van Alphen
Meggie Voogt

Image right: High performance liquid chromatography machine for measuring neurotransmitters in the brain.

Lab Head **Dr Elizabeth Coulson**



Lab **members**

Adam Hamlin
Georg Kerbler
Linda May
Nick Palstra
Alex Sykes

The primary research goal of Dr Elizabeth Coulson's laboratory is to identify and characterise the regulators of neurodegeneration and neuronal death. *By understanding the fundamental molecular mechanisms of this process, researchers aim to eventually develop therapeutics to treat neurodegenerative diseases. The Coulson group has also been focusing on characterising the cell death signalling pathway mediated by the p75 neurotrophin receptor. p75 is a neural death receptor activated in a number of neurodegenerative conditions including Alzheimer's disease and motor neuron disease.*

The laboratory's current research aims are based on their expertise in studying the structure and function of p75.

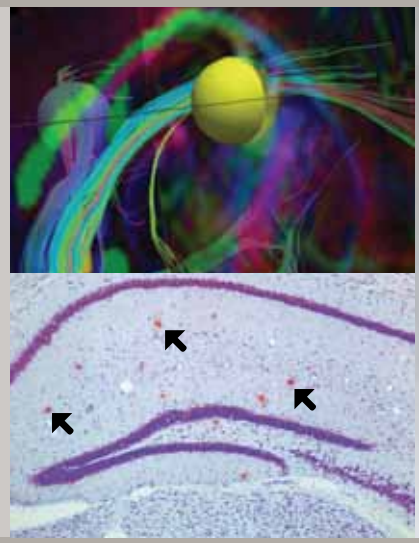


Image above: MRI image of basal forebrain axons (coloured lines) entering the hippocampus (yellow). Image below: Brain slice showing amyloid plaques (orange) in the hippocampus.

Understanding neuronal death in Alzheimer's disease

Alzheimer's disease is believed to be caused by the build up of a toxic protein called amyloid beta, which leads to nerve degeneration and neuronal death, and results in cognitive decline. In Alzheimer's disease patients a particular region of the brain – the basal forebrain – undergoes considerable degeneration for reasons that are unclear.

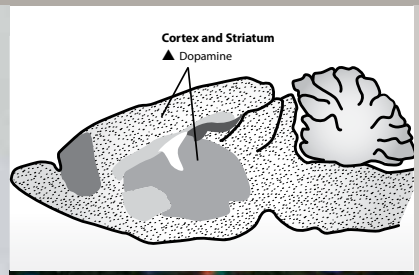
In 2009 the Coulson laboratory built on its significant 2008 finding that the p75 neurotrophin receptor is necessary for amyloid beta to cause nerve cell degeneration in the basal forebrain. In this study researchers found it was possible to block amyloid beta toxicity by removing the p75 cell death receptor. This result caused the discipline to change its thinking about why and how nerve cells die in Alzheimer's disease and to investigate new ways by which neurons might be protected against amyloid beta.

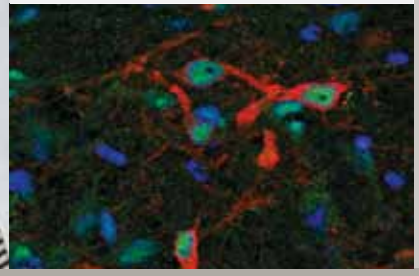
While p75 is known to cause the death of basal forebrain neurons, another receptor, TrkA, can promote their survival and can physically interact with p75. The group found that p75 receptor proteolysis might be the key to promoting optimal TrkA survival signalling. This finding suggests it may be possible to switch the function of p75 through manipulation of its proteolysis so that, rather than causing neuronal death, it promotes neuronal survival. This idea will be pursued in collaboration with Danish colleagues.

The Coulson laboratory also has other ongoing projects investigating the regulation and activation of p75 death signalling in cholinergic neurons in Alzheimer's disease, including testing whether disrupting p75 function can prevent degeneration and cognitive decline in animal models.

Image left: Hippocampal neurons in a culture dish stained for p75 (green) and a neuron scaffold marker (red).

Lab Head **Dr Darryl Eyles**





Dr Darryl Eyles' laboratory is primarily focused on the modelling of the non-genetic risk factors for schizophrenia.

This work has highlighted the effect of vitamin D on a person's likelihood to develop schizophrenia. Most noticeably, research in animal models has demonstrated that developmental vitamin D (DVD) deficiency in newborns increases the chances of developing the disorder in later life.

Further, work from this group has firmly established that vitamin D regulates brain development.

The group is also part of the Queensland Centre for Mental Health Research.

Image above: Diagram of an adult rat brain. Image below: The mesencephalon (or midbrain) of a rat at birth.

Understanding the neurobiology of serious mental illness

Working in close collaboration with QBI's Professor John McGrath's and Dr Thomas Burne's research groups, the Eyles laboratory continues to examine the consequences of DVD deficiency on both brain and development function. Research has shown direct reductions in specification and maturation factors for dopaminergic neurons in foetal DVD-deficient brains, which correlate with disturbances in brain function both at the level of locomotion and selective attention.

The group is rewriting the paradigm that dopamine may not represent a final common pathway for schizophrenia. Rather it may be the initial common abnormality in brain development that precipitates the multiple disturbances seen in other neurotransmitter systems in this disorder. Currently researchers are modelling how alterations in dopamine levels affect brain development and behaviour in animal models such as the rodent, zebrafish, fruit fly and mosquito. The use of a variety of model animals continues to provide a diverse and flexible research platform in understanding the neurobiology of serious psychiatric disease.

In clinical research, the Eyles laboratory has developed possibly the world's most sensitive assay for 25 hydroxyvitamin D, detecting tiny amounts of this vitamin in paediatric dried blood spots. Apart from being successfully used to indicate that low vitamin D levels are associated with schizophrenia in later life, this assay is now being used in the laboratory to assess the vitamin's role in cancer, diabetes and multiple sclerosis.

Image right: The laboratory investigates brain development in species including fruit flies, zebrafish and embryonic rodents. Studies in neonatal dried blood spots have shown children with altered levels of 25 hydroxyvitamin D have an increased risk of developing schizophrenia.

Lab **members**

Suzanne Alexander
Eamon Byrne
Jacqueline Byrne
Luke Carrol
Xiaoying Cui
Carlie Cullen
Trudi Flatscher-Bader
Claire Foldi
Isabelle Formella
Lauren Harms
James Kesby
Pauline Ko
Matt Pelekanos
Karthik Purushothaman
Henry Simila
Karly Turner
Bart van Alphen
Meggie Voogt

Lab Head **Professor John McGrath**

Lab members

Suzanne Alexander
Eamon Byrne
Jacqueline Byrne
Luke Carrol
Xiaoying Cui
Carlie Cullen
Trudi Flatscher-Bader
Claire Foldi
Isabelle Formella
Lauren Harms
James Kesby
Pauline Ko
Matt Pelekanos
Karthik Purushothaman
Henry Simila
Karly Turner
Bart van Alphen
Meggie Voogt

Researchers in Professor John McGrath's laboratory generate and evaluate the non-genetic risk factors of schizophrenia.

Using animal models, the group has forged productive cross-disciplinary collaborations linking risk factor epidemiology with developmental neurobiology. For example, based on clues from the epidemiology of schizophrenia, the McGrath group has made significant discoveries about the importance of prenatal vitamin D (the 'sunshine hormone') on brain development.

In addition, Professor McGrath has supervised major systematic reviews of the incidence, prevalence and mortality of schizophrenia.

The group is also part of the Queensland Centre for Mental Health Research.

Image above: Professor McGrath in discussion with a patient. Image below: Children of older fathers may be at risk of schizophrenia.

Preventing schizophrenia

Schizophrenia is associated with a substantial burden of disability. In the absence of major treatment advances, interventions that offer the prospect of reducing the incidence of the disorder should be pursued vigorously.

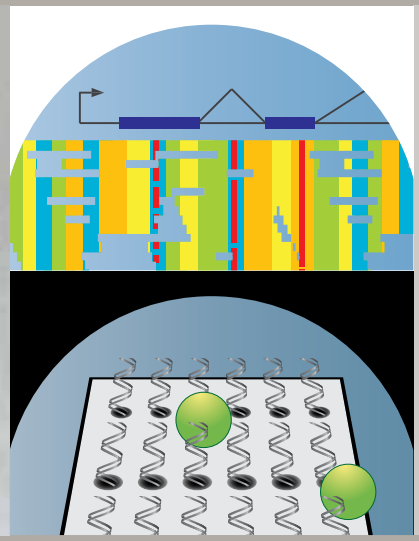
Working with Danish collaborators, the McGrath group used blood samples from newborn babies to confirm that a deficiency in neonatal vitamin D levels is linked to a higher risk of developing schizophrenia. If future studies confirm the association between developmental vitamin D deficiency and a higher risk of schizophrenia, then it could raise the prospect of primary prevention – in a manner comparable to the folate supplement and the prevention of spina bifida.

In March 2009, the laboratory published the results of a large study linking a father's age at time of conception to his offspring's brain development – the older the father, the more likely his children were to have lower cognitive ability (or IQ). While it has long been appreciated that maternal age is linked to conditions such as Down syndrome, paternal age has been somewhat neglected. The researchers are now part of a collaboration further examining the issue in a mouse model.

Group researchers Dr Traute Flatscher-Bader and Ms Claire Foldi have also been exploring behavioural, genomic and brain imaging in a mouse model, while Dr Bart van Alphen has collaborated with QBI's Professor Jason Mattingley and Assoc. Professor Bruno van Swinderen to explore the attentional function of the fruit fly. These types of research provide an opportunity to interrogate integral questions using the different strengths each animal offers.

Image left: Inset of *Face face La Homme,* painted by Paul Munro.

Lab Head **Professor Bryan Mowry**



The primary research goal of Professor Bryan Mowry's laboratory is to identify and functionally characterise susceptibility genes for schizophrenia using clinical, molecular and statistical genetic approaches.

The laboratory is participating in the international Psychiatric Genetics Consortium, which is conducting the largest ever genome-wide association study. Mowry researchers have a special interest in ethnically homogeneous populations in an Australian cohort of twins who have psychotic disorders and are participating in recruitment and analysis for the Australian Schizophrenia Research Bank. The group's focus on alternate clinical phenotypes for use in research is expanding to incorporate second generation sequencing in order to identify rare variants for functional validation.

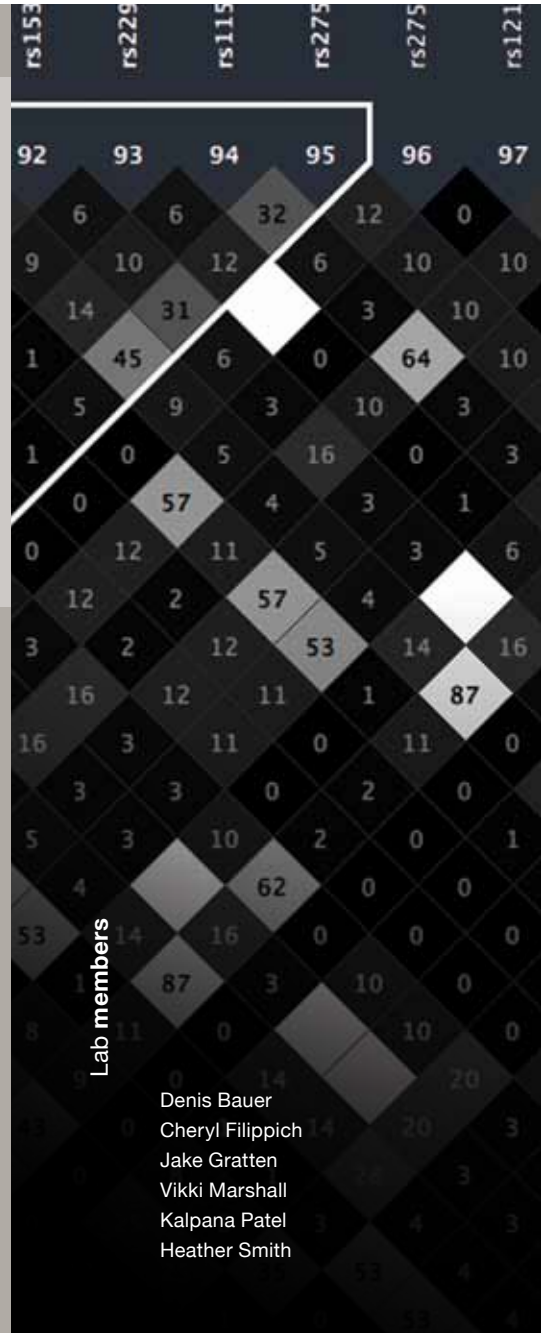
All images: Computer modelling created during the gene characterisation process.

Identifying susceptibility genes for schizophrenia

In late 2009, the Psychiatric Genomics laboratory was established at QBI and in November two projects were funded by the National Health and Medical Research Council. The first was a five-year grant to study the molecular basis of schizophrenia in a large, globally competitive Indian sample. This project will recruit 5,000 individuals (people affected with schizophrenia and healthy controls) who will then be screened using over 1 million DNA markers to identify common variants associated with disease. Gene expression studies and pathway analysis will also be conducted in this cohort.

The second is a three-year project to identify genetic variation underlying gene expression in a large Australian schizophrenia sample. The group will conduct genome-wide association and gene expression studies in the same cohort of schizophrenia cases and healthy controls with the goal of identifying genetic variants associated with gene expression. Researchers will also study a subset of individuals with schizophrenia who have documented structural genetic variants (copy number variations - CNVs), comparing them with a range of healthy controls and individuals with schizophrenia who do not have CNVs.

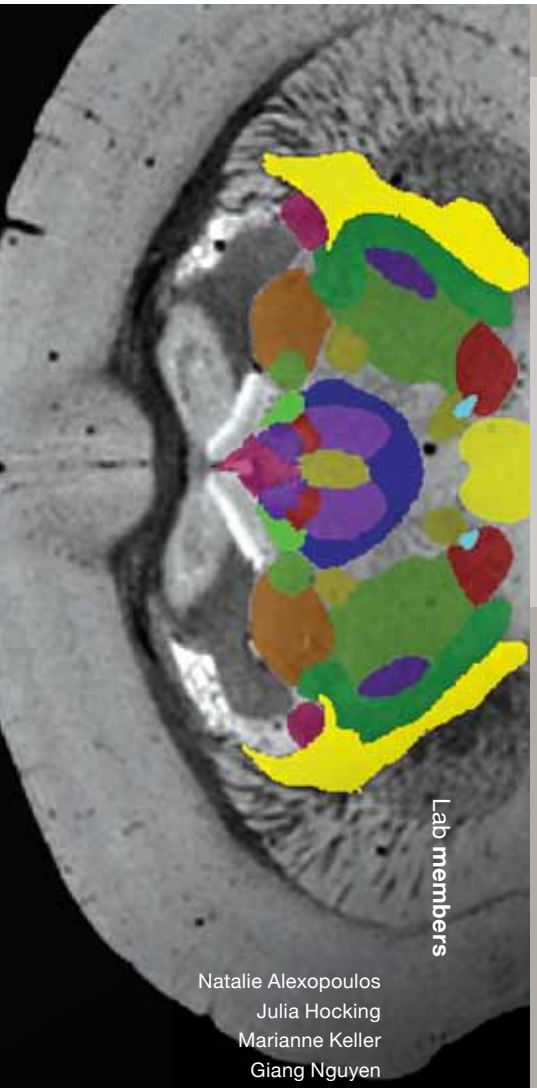
In collaboration with the Claudianos and van Swinderen laboratories, the group is studying whether autism and schizophrenia share a common genetic predisposition. In the honeybee and fruit fly models, the groups plan to experimentally validate a prioritised orthologue subset of schizophrenia and autism candidate genes and subsequently screen these genes in large-scale human cohorts. This research could lead to the identification of genetic variants associated with schizophrenia and provide a strong foundation for conducting further functional studies to substantiate causal involvement of identified variants.



Lab **members**

Denis Bauer
Cheryl Filippich
Jake Gratten
Vikki Marshall
Kalpana Patel
Heather Smith

Lab Head **Professor David Reutens**

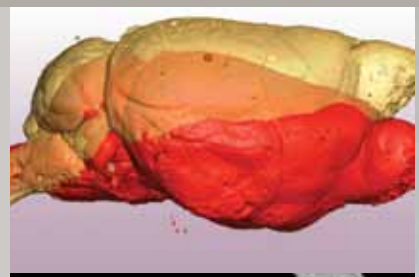


Lab members

Natalie Alexopoulos
Julia Hocking
Marianne Keller
Giang Nguyen
Pilitta Valenica
Viktor Vegh
Taracad Venkatachalam
Jana Vukovic
Deming Wang
Steven Yang

Researchers in Professor David Reutens' laboratory use imaging to study diseases such as epilepsy and stroke. *Using magnetic resonance imaging (MRI), group members are working to develop and validate more accurate methods of functional brain mapping. These methods are being used to examine memory function in epilepsy and to study the abnormal brain networks underlying the disorder.*

Further, through the Australian Mouse Brain Mapping Consortium (AMBMC) researchers are using information from imaging and microscopy to create more accurate brain atlases. The group is also working to develop new biomarkers for the development and treatment-responsiveness of epilepsy.



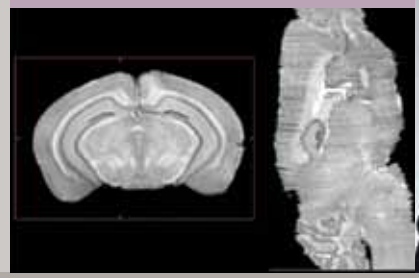


Image above: Transformation of mouse brain into canonical reference space. Image below: Volume reconstruction of histological sections of mouse brain.

Using image analysis to study disease

2009 proved a productive year in the Reutens laboratory with a number of new researchers joining the group to work across several key areas.

Researchers are undertaking image analysis, in which they are developing methods of using MRI data to obtain more accurate positron emission tomography (PET) images, thereby improving the quality of images from hybrid MRI-PET scanners. Neuroscientists are also working on methods for increasing image resolution and contrast with MRI, and developing ways of generating three-dimensional volumes from two-dimensional histological sections.

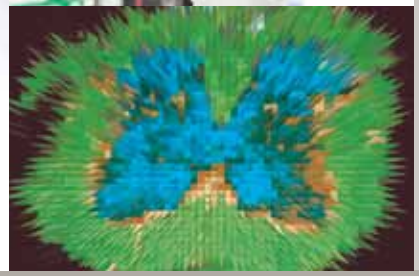
The prime objective of the group's research into the use of functional MRI (fMRI) in memory and epilepsy is to develop tasks that probe specific functional components of the memory system in the general population. These tasks will then be tested on patients with intractable temporal lobe epilepsy to aid pre-surgical assessment of functional anatomy and inform predictions of post-operative cognitive outcomes.

The Reutens group is also part of the AMBMC, which provides a national facility where researchers can characterise neurological disease in mouse models. It uses imaging, computational anatomy and image analysis to enable multi-dimensional statistical comparisons of brain anatomy between the mouse model and background strain.

Further, researchers are developing a new MRI contrast mechanism for the detection of neuronal currents, to enable a more direct and accurate high spatial resolution visualisation of neuronal activity.

Image left: Segmentation of thalamic nuclei in magnetic resonance images of a 12 week old mouse brain.

Lab Head **Dr Robyn Wallace**



The main focus of Dr Robyn Wallace's laboratory is the genetics of neurological disorders such as motor neuron disease (MND) and epilepsy.

MND is a rare, incurable disorder with late onset. Although most MND cases are not familial, a small percentage are due to genetic mutations. The group is using advanced genomic techniques to understand how these genes cause MND and to test potential treatments.

Epilepsy is a common, complex disorder with a strong genetic component. Already the Wallace laboratory has successfully identified several human epilepsy genes and is continuing to characterise the functional consequences of the mutations.

Image above: Dr Marie Mangelsdorf working in the laboratory. Image below: Adapted from a magnetic resonance imaging scan of a mouse spinal cord.

Understanding the genetics of brain disorders

In 2009 the Wallace laboratory established a collaboration with researchers at the University of Sydney and Griffith University to study the role of a newly discovered MND gene, TDP-43. This gene is a DNA/RNA binding protein involved in gene regulation, however its function in the nervous system is currently unknown and its role in the pathogenesis of MND remains unclear. The collaboration has identified gene targets of TDP-43 and is investigating the functional consequences of TDP-43 mutations in MND patient cells. The project has the potential to provide crucial insights into understanding how motor neurons degenerate in MND and to identify novel therapeutic targets.

The group has recruited a research nurse to collect patient samples from the Royal Brisbane and Women's Hospital's MND clinic. By establishing a bank of samples, which can identify biomarkers specific to the disease, researchers are hoping to improve diagnosis and identification of MND mechanisms.

Neuroscientists are also studying the genetics of progressive myoclonic epilepsy (PME). In 2009 the group discovered a mutation in the PRICKLE1 gene that causes a specific form of PME associated with ataxia. PRICKLE1 is a regulator of the Wnt signalling pathway, a cellular communication pathway that plays critical roles in development and disease. This was the first report of an epilepsy gene directly involved in Wnt signalling and defines a new pathway involved in the pathogenesis of human epilepsy. Researchers are now investigating exactly how mutations in PRICKLE1 alter nerve cells in the brain to make them susceptible to seizure activity.

Image right: Section of the spinal cord from a mouse model of MND.

Lab members

Tim Butler
Marie Mangelsdorf
Ramesh Narayanan
Kate Noakes
Ajay Panwar

Lab Head **Mr Geoffrey Osborne**

Mr Geoffrey Osborne is QBI's Director of Flow Cytometry, which is a technique that allows scientists to separate and count microscopic particles. *The laboratory specialises in the analysis and separation of cells derived from a variety of sources such as solid tissue, blood and cultured cell lines.*

Operationally, the laboratory has two main goals – the provision of a flow cytometric service to researchers at the Queensland Brain Institute and across The University of Queensland, and fundamental research into the application of this technology in neuroscience through the development and application of novel assays. Development varies from physical hardware design and implementation through to methodological testing.

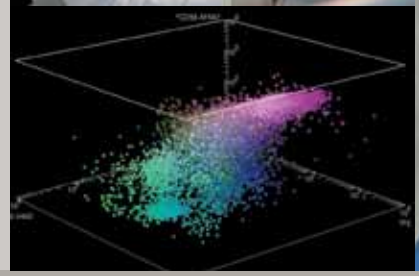


Image above: Virginia Nink and John Wilson in the laboratory. Image below: Characterisation of brain tumour cells based on surface marker expression.

Advancing technologies for defining cell types

In 2009 the Osborne group designed an assay combining multiple measurable parameters at one time to increase sample throughput and decrease sample volumes required to obtain a result. This was achieved by creating a unique fluorescence colour 'bar coding' of cell groups, so that when all groups are added to the same tube, each original group can be identified during analysis. This allows researchers to measure the levels of molecules in and on cells from many different groups simultaneously, and to identify changes in surface molecules present on stem cells as they develop.

Researchers then sought to enhance this approach by designing mixing hardware to allow the reading of functional responses following the addition of compounds to live multiplexed cells. This development is aiding research projects where there is a requirement for measuring live cell responses in a high throughput, high content manner.

As there is a need to separate particles that are too large for conventional flow cytometers, such as fly eggs and worms, microfluidic devices have also been developed. Although research into these small disposable silicone devices is ongoing, they already hold the promise of large advances in experimental possibilities.

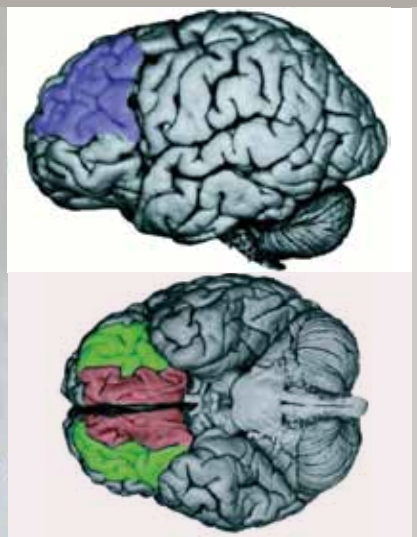
In addition, the laboratory's long-standing research into the most aggressive form of brain tumour, *Glioblastoma multiforme*, has continued. The Osborne laboratory has explored the role of photoporphyrins as markers of tumour cells and the applicability of these compounds to act as a guide for surgical resection. It is hoped this work will eventually lead to better outcomes than existing treatments.

Image left: Example images of cells analysed for the co-localisation of two fluorescent reporters using the AMNIS IS100 imaging cytometer.

Lab members

Virginia Nink
John Wilson

Lab Head **Dr Louise Faber**



Dr Louise (Luli) Faber's laboratory is interested in the functioning of a brain region called the prefrontal cortex, which is located at the front of the brain. *It is involved in higher functions such as working and long-term memory, emotion regulation and cognitive flexibility.*

Working memory, which is known to malfunction in a number of neurological disorders such as schizophrenia, attention deficit hyperactivity disorder and depression, is the ability to hold conceptual information in the mind in the presence of distractions. This information may be used at a later time to guide thoughts and behaviour. The laboratory is interested in the mechanisms by which this information is retained in the prefrontal cortex at the cellular level.

Image above and below: The location of different regions of the prefrontal cortex in the human brain.

Unravelling the circuitry of long-term memory

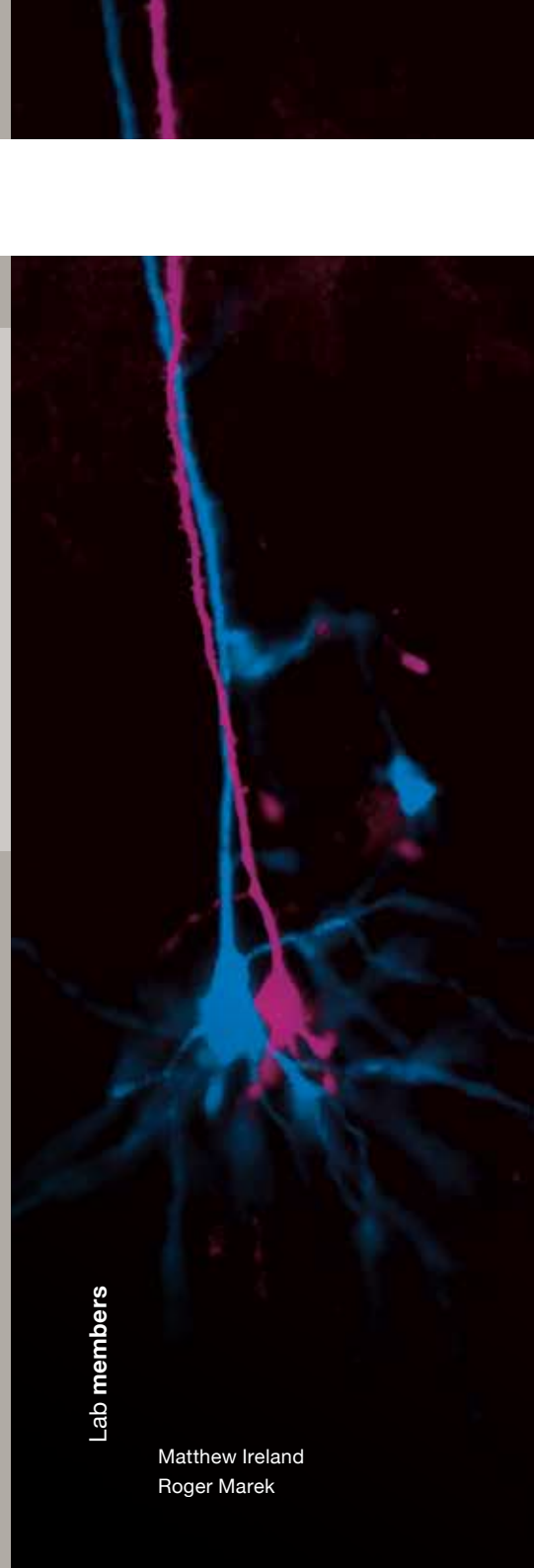
The Faber laboratory studies the prefrontal cortex by recording the electrical activity of layer 5 neurons within the brain. Using this technique the group can examine the intrinsic properties of these neurons and study how they communicate with each other, through the process of synaptic transmission, in the prefrontal cortex. These factors are thought to contribute to repetitive firing activity observed in these neurons during working memory tasks.

The group is also researching the mechanisms through which long-term memories are stored, by studying how the strengths of connections between neurons change over time through the process of synaptic plasticity.

In 2009 the Faber laboratory identified new mechanisms by which synaptic transmission in layer 5 pyramidal neurons is regulated in the prefrontal cortex. This involved regulation by a number of ion channels, including NMDA receptors, SK channels and voltage-gated calcium channels. By looking at the intrinsic properties of neurons the group identified the way in which layer 5 neurons switch from a quiescent state to a more active firing state, which is likely to contribute to the repetitive firing seen during working memory tasks.

Finally, the laboratory has shown that SK channels act as a brake on synaptic plasticity, preventing the induction of long-term depression and a long-term potentiation following bursts of activity that are likely to occur during working memory.

Together these findings have contributed to understanding of the cellular mechanisms underlying higher brain function in the prefrontal cortex.



Lab **members**

Matthew Ireland
Roger Marek

Image right: Fluorescent staining two pyramidal neurons in the rat prefrontal cortex.

Lab Head **Professor Joe Lynch**

The major research interest in Professor Joe Lynch's laboratory concerns the molecular structure and function of the structurally related glycine and $GABA_A$ receptors, which mediate inhibitory neurotransmission in the brain.

The $GABA_A$ receptor is an important target for neuroactive drugs and the glycine receptor has recently emerged as a potential drug target for pain, epilepsy and tinnitus. The Lynch group is attempting to understand how these receptors open and close, and the locations of drug binding sites.

The researchers are also interested in identifying novel drugs active at these receptors which could lead to improved therapies and better pharmacological tools for basic research.

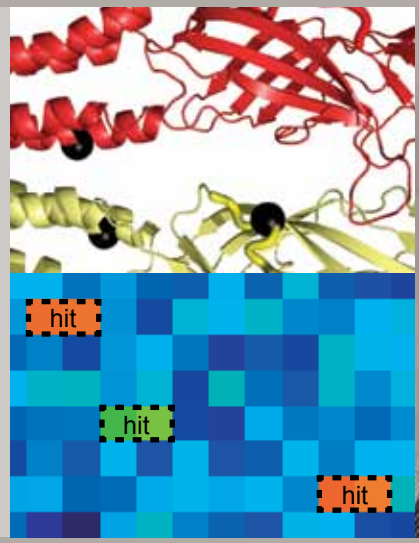


Image above: Graphical representation of the critical structures of a receptor, where agonist binding couples to ion channel opening.
Image below: Output from an automated assay that identifies novel therapeutic leads from a library of thousands of natural compounds.

Developing new drugs that mediate nerve function

In 2009 the Lynch laboratory published several studies that significantly advanced the understanding of how glycine-activated inhibitory neurotransmitter receptors open and close. The group made the unexpected discovery that different agonists (a drug that binds to a receptor and triggers a response) binding to receptors activate them by distinct structural rearrangements. Further, researchers discovered a conformational change that was correlated with agonist efficacy. As many drugs are low efficacy agonists, this finding could help scientists establish exactly how they work.

A major focus over the last several years has been to identify how clinically important drugs bind to the glycine receptor, with a view to developing new lead compounds for anti-inflammatory medications. In 2009 researchers successfully identified binding sites for dihydropyridines, beta-carbolines and ivermectin, which are all clinically important compound classes. During the course of the study, the group seized the opportunity to develop an improved neuronal silencing receptor based on a glycine receptor modified to make it highly sensitive to activation by orally ingested medication but insensitive to glycine. It is expected this will be an important tool for correlating particular animal behaviours to the activity of specific neuron populations in the brain and could eventually have therapeutic applications.

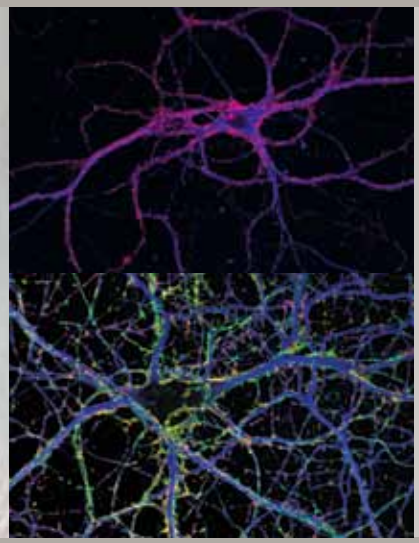
In collaboration with others, the group has recently discovered several potent new glycine receptor-active compounds by high throughput screening of natural product libraries. The potencies and pharmacological profiles of several compounds suggest possible therapeutic treatments for pain and as pharmacological tools for basic research.

Image left: A view of the interaction between a drug molecule and its target receptor in the nervous system at the atomic resolution.

Lab members

Anna Bode
Xuebin Chen
Christine Dixon
Prudence Donovan
Florian Gebhardt
Daniel Gilbert
Justine Haddrill
Robiul Islam
Han Lu
Tim Lynagh
Floyd Qiang Shan
Qian Wang
Tim Webb
Yang Zhe

Lab Head **Assoc. Professor Frederic Meunier**



Neurons are highly polarised cells that transport membrane compartments known as organelles. *With various origins and defined destinations they underpin fundamental functions, such as neuronal communication, through the timely release of neurotransmitters at the synapse. They can also carry many important survival factors from the synapse back to the cell body.*

Assoc. Professor Frederic Meunier's laboratory is designing fluorescent probes and state-of-the-art live cell microscopy. In combination with the power of proteomics, electrophysiology, structural biology and biochemistry this equipment will lead to a better understanding of the molecular mechanisms underpinning the many different forms of neuronal membrane trafficking.

All images: Confocal images of immunolabelled cultured hippocampal neurons.

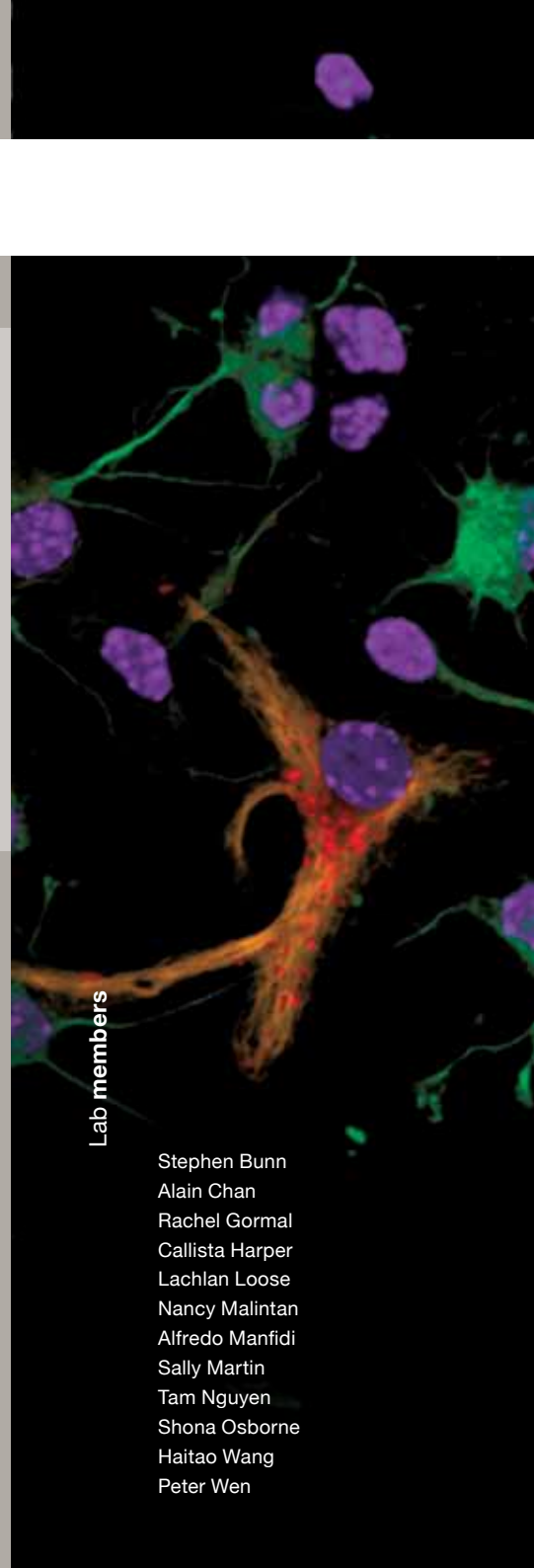
Investigating neuronal trafficking and communication

Despite decades of research, the molecular mechanism underpinning exocytosis (the trafficking of information out of a cell) remains poorly understood. Emerging trends suggest that the protein Munc18-1 acts as a chaperone to promote the delivery of Syntaxin1, an essential protein for exocytosis to the plasma membrane via a yet to be characterised trafficking pathway.

The Meunier laboratory and its collaborators have hypothesised that the Munc18-1 trafficking pathway is responsible for populating the plasma membrane with Syntaxin1. This is a highly significant trafficking pathway as secretory vesicles rely on Syntaxin1 to undergo regulated fusion. Researchers believe the failure of this pathway at any stage completely blocks neuroexocytosis in neurons, neurosecretory cells and insulin-releasing cells. In 2009 the group published two papers laying the basis of this hypothesis.

They have also uncovered a novel form of regulation helping secretory vesicles to acquire the competence to release their content by exocytosis. This provides the first demonstration of a link between calcium and PI3-kinase signalling pathways.

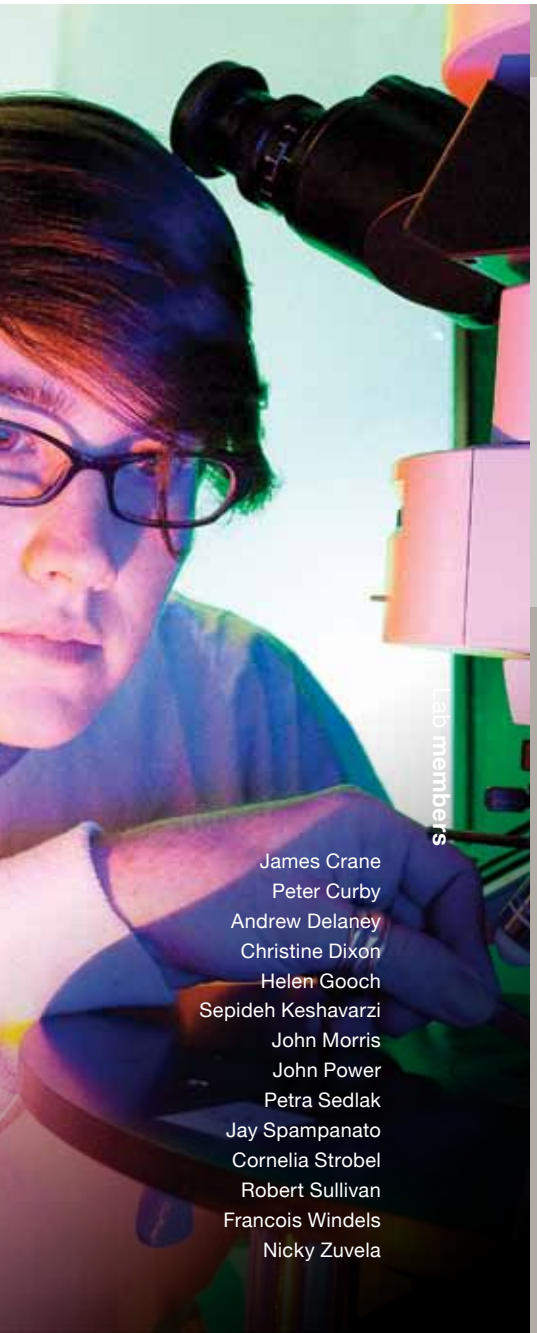
This research provides the basis for a more dynamic view of the secretory mechanism of neurotransmitter release, with important implications for the treatment of conditions characterised by the diminished release of a neurotransmitter/hormone. The Meunier group envisages this knowledge could eventually lead to treatments for neurodegenerative conditions such as Alzheimer's and Parkinson's disease, diabetes and epilepsy.



Lab **members**

Stephen Bunn
Alain Chan
Rachel Gormal
Callista Harper
Lachlan Loose
Nancy Malintan
Alfredo Manfidi
Sally Martin
Tam Nguyen
Shona Osborne
Haitao Wang
Peter Wen

Lab Head **Professor Pankaj Sah**



Lab members

James Crane
Peter Curby
Andrew Delaney
Christine Dixon
Helen Gooch
Sepideh Keshavarzi
John Morris
John Power
Petra Sedlak
Jay Spampanato
Cornelia Strobel
Robert Sullivan
Francois Windels
Nicky Zuvela

The focus of Professor Pankaj Sah's laboratory is to understand how sensory information reaches the amygdala and is processed there. *The amygdala assigns emotional content to our sensory world and contributes to why we see some events as happy and others as sad. Activity in this region is also the reason that events with emotional significance, such as weddings and children's births, are easily and well stored in our memories.*

Dysfunction of the amygdala leads to a range of disorders including anxiety, phobias and post-traumatic stress syndrome. The group is interested in understanding the circuits of the amygdala using cellular and molecular techniques, with the long-term goal of discovering molecular targets for the development of treatments for anxiety-related disorders.

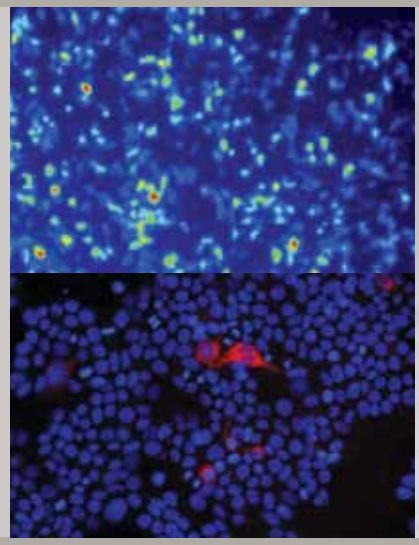


Image above: HEK cells transfected with the fluorescent marker YFP_{I125L}. Image below: HEK293T cells transfected with lentivirus constructs containing VChR1, hChR2 and NpHR.

Synaptic Plasticity

Understanding learning and memory formation

Until recently, work in the Sah laboratory focused on recordings in acute brain slices to understand the anatomy and physiology of the internal circuits within the region of the brain known as the amygdala.

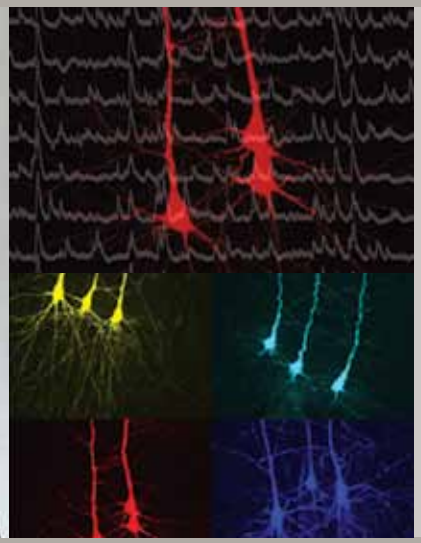
Now researchers in the group have developed recording techniques using tetrodes implanted in awake behaving animals in which the activity in the amygdala and other connected brain regions is recorded as they undergo behavioural tasks that engage the amygdala. These recordings allow researchers to follow the cellular activity of different regions of the brain, in particular the amygdala, as the animals learn and remember.

Using two-photon imaging, researchers in the Sah group have also examined how synaptic inputs impinging on pyramidal neurons in the basolateral amygdala initiate calcium signalling mechanisms. This has led to the finding that synaptic activity initiates calcium waves in dendrites that propagate to the nucleus. These calcium waves also invade some dendritic spines but do not enter others. Changes in calcium are likely to underlie how learning takes place in the amygdala.

NMDA receptors are activated by glutamate and initiate the molecular events that underlie learning and memory formation. These receptors are made up of combinations of different subunits that are thought to play different roles during the learning process. Using a combination of molecular manipulation and physiology in acute brain slices, the Sah group has also examined the distribution of different subunits that make up NMDA receptors at different synapses in the amygdala.

Image left: Helen Gooch working in the laboratory.

Lab Head **Assoc. Professor Stephen Williams**



Networks of neurons are connected together by synapses, which allow information transfer between cells. *A single neuron in the central nervous system may receive thousands of synaptic inputs distributed widely across its dendritic arbor. A fundamental operation of neurons is the integration of such time varying input signals to form an output signal, termed the action potential, which is communicated to other neurons and/or effector systems such as muscles.*

Researchers in Assoc. Professor Stephen Williams' laboratory are investigating key questions of single neuron computation by generating diverse spatial and temporal patterns of synaptic inputs in central neurons maintained in vitro.

All images: A single neuron can receive thousands of synaptic inputs.

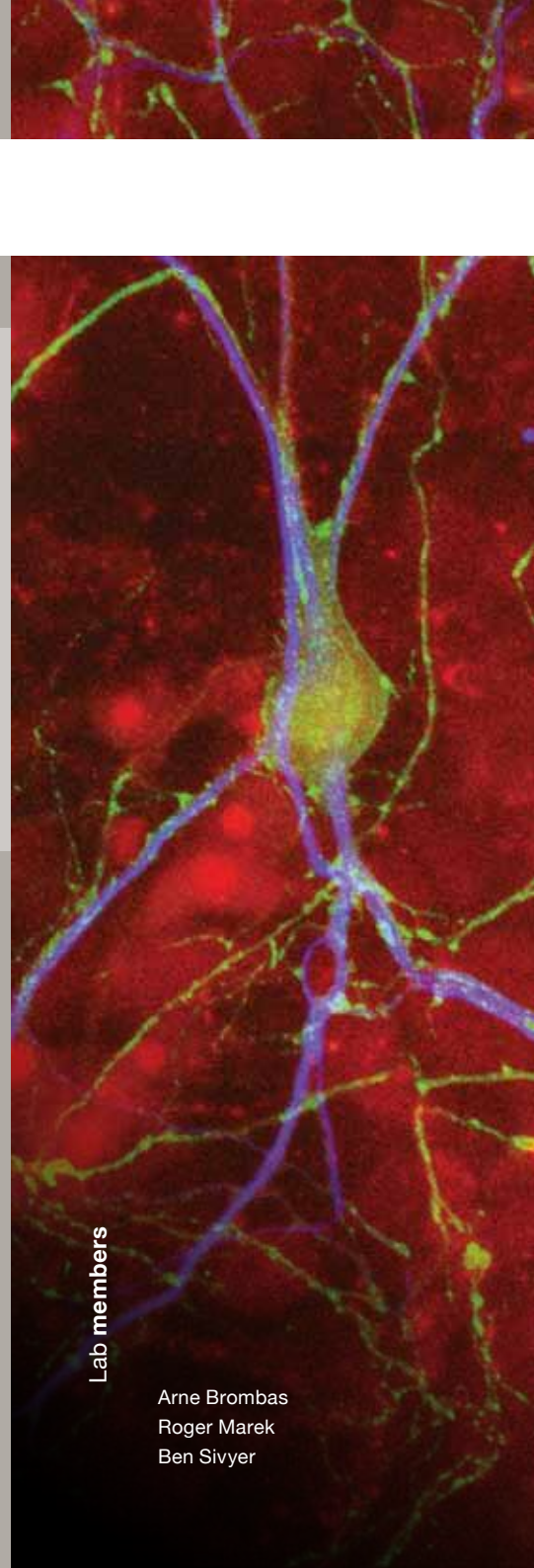
Investigating the operation of neuronal circuits

Assoc. Professor Williams was recruited to QBI from the MRC Laboratory of Molecular Biology, Cambridge, UK in December 2009.

To date, researchers have established four electrophysiological setups equipped with recording and imaging (two-photon) apparatus. The group uses advanced electrophysiological techniques that allow simultaneous recording from multiple dendritic sites of a single neuron and computational modelling to explore the synaptic integration mechanism in neurons of diverse morphology.

The group's aims are focused on understanding the computational operations of the most numerous neuronal classes in the brain region called the neocortex (pyramidal neurons) and their relation to the physiological function of neuronal networks. To explore this, researchers will activate determined neuronal pathways in the neocortex using light-activated ion channels and measure how such input signals are integrated in the dendritic tree using multi-site electrophysiological recording techniques.

The group has two postdoctoral fellows, which allows space for expansion in the coming year. Further, researchers are involved in a collaboration with research groups at the Howard Hughes Medical Institute, Janelia Farm Research Campus, USA. Through the use of multi-site two-photon glutamate uncaging techniques researchers are exploring the determinants of dendritic synaptic integration. This research will enable neuroscientists to better understand how networks and single neurons function in the neocortex and how these processes are disturbed in disease.



Lab **members**

Arne Brombas
Roger Marek
Ben Sivyer

Lab Head **Dr Charles Claudianos**

Dr Charles Claudianos' laboratory examines molecular principles underlying sensory processing, learning and memory in a postnatal brain using flying insects as research models.

The honeybee has a relatively large brain that changes in response to sensory experience, which is similar to humans. Its sophisticated behavioural repertoire makes it a superior model species to examine brain changes associated with sensory experience. Meantime, the fruit fly Drosophila *is used to confirm the role of candidate genes in development and behaviour.*

The group is researching the role of the neurexin-neuroligin protein complex in synaptic development, the molecular basis of olfactory adaptation and the molecular systems involved in autism and schizophrenia.

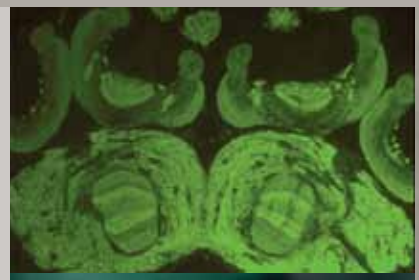


Image above: Neurexin 1 related slices from the honeybee brain. Neurexin 1 in humans is associated with cognitive disorders such as autism and schizophrenia. Image below: When honeybees associate an odour with sugar water their brains surge with neurexin 1.

Understanding molecular processes in sensory response

In 2009 the Claudianos laboratory established a collaboration with QBI's Professor Bryan Mowry and Assoc. Professor Bruno van Swinderen modelling autism and schizophrenia genes using a molecular systems approach. Using the concept 'humans to insects back to humans again' allows the collaborators to investigate genes and molecular processes associated with cognitive disorders.

To date, the group's research has indicated more than a quarter of putative cognitive disease-associated genes, including synaptic proteins such as neurexin and neuroligin, are common in insects and humans. Using insect model species to understand the role of these molecules in the brain, the groups are verifying a link to memory, learning and attention processes that are diagnostic features of cognitive disease. This approach enables the screening of many candidate disease genes, and associated molecular processes, providing biological relevance and confidence to engage deep genome sequence analysis of affected humans.

In collaboration with researchers at UQ's Faculty of Social and Behavioural Sciences, the Claudianos group has characterised the chemoreceptor family of proteins from the marine mollusc *Aplysia*. This project has demonstrated that the mollusc has differentially expressed olfactory and gustatory sensory organs.

Further, PhD student Partha Bhagavatula has shown that visual edge detection in birds is similar to that previously reported for insects and involves contrast-dependent and colour-independent visual detection. This evolutionary adaptation is likely to predate the split between vertebrates and invertebrates and could further inform research into neurological disorders in the future.

Image left: Atomic structure of neurexin 1 protein, associated with cognitive disorders such as autism and schizophrenia.

Lab **members**

Partha Bhagavatula
Alexandre Cristino
Nivetha Gunasekaran
Melanie Havler
Miguel Renteria
Janelle Scown

Lab Head **Dr Judith Reinhard**

Dr Judith Reinhard's laboratory conducts research in the field of neuroethology.

This involves linking brain function to behaviour, by investigating how sensory information from the environment is processed in the brain and translated into behavioural activity. A particular focus is the sense of smell and its effect on memory and cognitive performance.

Researchers in the Reinhard laboratory are combining insect model systems with human research and behavioural studies with physiological and molecular approaches to investigate how complex information from natural scents is encoded in the brain. Further, the group is studying plastic olfactory processes and memories, and how the sense of smell affects learning, attention and decision making.

Image above: Honeybee at a feeder station. Image below: Illustration of a honeybee's brain

Linking sensory and cognitive processes

A major problem in olfactory research is that very little is known about which olfactory receptors detect which odours. This knowledge is crucial to understanding how odours are processed and learnt in higher brain centres. In 2009 neuroscientists in the Reinhard laboratory established a simple cell assay in collaboration with researchers in QBI's Claudianos laboratory to identify the specificities of honeybee olfactory receptors for floral odours.

Importantly, the researchers discovered that the 3-D structure of odour molecules plays a crucial role in whether or not the odour is detected. Armed with this knowledge, the team was able to establish that the molecular mechanisms underlying the sense of smell in honeybees are highly plastic and, consequently, that scent perception and learning change across the honeybee's lifespan.

The Reinhard laboratory also discovered that natural scents, which are complex mixtures of dozens of different odorants, are processed and encoded via a selection of key odorants. That is, the honeybee brain is capable of filtering out the majority of the information and only learning a key odorant signature for each complex scent. This simple reductionist strategy helps the brain manage the massive amount of information contained in natural scents, thus enhancing processing speed and capacity.

In 2010 the laboratory will investigate whether humans also use the key odorant strategy of scent processing, and whether the human sense of smell is similarly plastic to that of the honeybee.

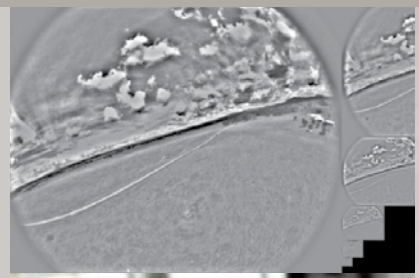
Lab **members**

Alexandre Cristino
Melanie Havler
Miguel Renteria
Amanda Robinson
Janelle Scown

Lab Head **Professor Mandyam Srinivasan**

Flying insects display remarkable visual agility and demonstrate a rich behavioural repertoire, despite carrying relatively small brains and simple nervous systems. *Insect brains have remarkably similar characteristics to the human brain, which gives scientists a useful reductionist model for research.*

Professor Mandyam Srinivasan's group uses the honeybee as a model to understand how visual information – such as vision, touch and motor control – is used to flawlessly guide flight and facilitate navigation. A related aim is to explore whether some of their insights can be used to devise novel, biologically inspired strategies for the guidance of autonomous aerial vehicles.



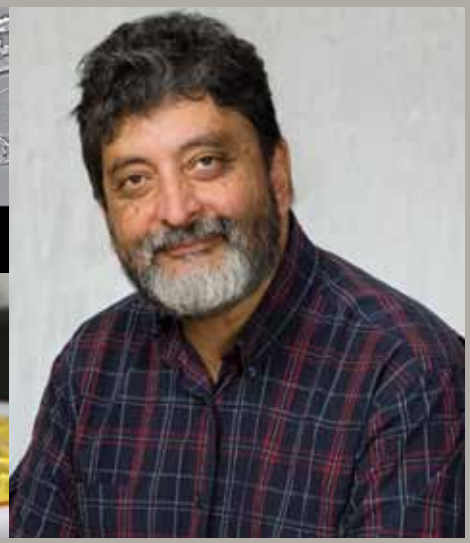


Image above: Example of a spatially filtered, wide-angle image used by the vision system developed to control aircraft flight.
Image below: Honeybees being rewarded with drops of sugar water at a target.

Lab members

Partha Bhagavatula
Daniel Bland
Natalie Bland
Carla Evangelista
Nikolai Liebsch
Tien Luu
Eliza Middleton
Richard Moore
Navid Nourani
Dean Soccol
Gavin Taylor
Saul Thurrowgood

Understanding vision, touch and motor control

Studies of honeybees flying in a virtual-reality arena have revealed a novel 'streamlining response' that reduces aerodynamic drag and energy expenditure during flight. The properties of the visual mechanisms that drive this response have now been fully characterised and work is underway in the Srinivasan laboratory to develop a virtual-reality flight simulator for insects.

In 2009, high-speed video footage of bees landing on platforms of various tilts uncovered the visual mechanisms that guide bees to smooth and safe landings. For example, in windy conditions bees always approach a target by flying upwind, thus achieving better flight control.

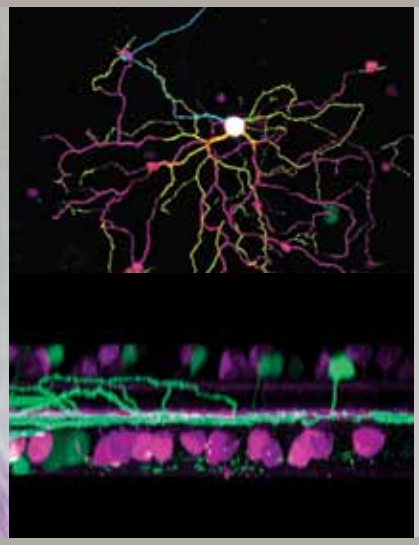
Further, high-speed films of aggressive honeybees revealed information about the visual mechanisms that mediate the detection, pursuit and interception of moving targets. The researchers established that these mechanisms appear tailored to facilitate quick and reliable guidance of these biological missiles to their targets and effective injection of venom into them.

The Srinivasan laboratory has also filmed budgerigars to uncover the strategies that birds use to negotiate narrow passages and avoid collisions with obstacles.

In the area of biologically inspired robotics, researchers achieved three major milestones in 2009. They designed, developed and successfully tested vision systems that provide honeybee-inspired visual odometry for automobiles, enabled an aircraft to perform terrain-following autonomously and automatically stabilised an aircraft's altitude by monitoring the position and orientation of the horizon.

Image left: Nikolai Liebsch displaying one of the test patterns used to investigate how honeybees achieve smooth landings in the presence of wind.

Lab Head **Professor David Vaney**



Professor David Vaney's laboratory is studying the output neurons of the retina, the retinal ganglion cells (RGCs), whose firing is conveyed to the brain along the optic nerve.

There are many distinct types of RGCs coding different aspects of the visual scene and researchers are analysing how visual response properties are produced by recording the input signals (synaptic currents) generated in the RGCs, in response to controlled visual stimuli.

Researchers in the Vaney group are investigating both the spatial and temporal properties of the synaptic inputs, with a particular focus on the role of the relative timing of the excitatory and inhibitory inputs.

Image above: Confocal reconstruction of a Neurobiotin-filled uniformity detector. Image below: Tissue labelled with ChAT (magenta) showing tracer-coupled amacrine cells (green).

Studying complex processing in the retina

In the 1960s, researchers discovered several types of RGCs with complex visual properties. Now, a productive collaboration between the Vaney laboratory and the Oregon Health and Science University, USA, has led to the characterisation of the synaptic mechanisms underlying the response properties of every type of complex RGC in the mammalian retina.

There are two types of RGCs that respond selectively to the direction of image motion – one type fires when light is turned both On and Off, while the other only fires when light is On.

At first glance the synaptic mechanisms underlying the generation of direction selectivity appear to be similar in the two types. However, studies using electrical recordings have shown that the synaptic inputs to the On-Off type are relatively constant over a wide range of temporal frequencies, whereas the On type receives less excitation and more inhibition at higher temporal frequencies. This suggests that the two types of direction-selective RGCs receive inputs from different types of excitatory and inhibitory retinal interneurons.

One type of RGC – termed the uniformity detector (UD) – responds to changes in the visual scene by decreasing its firing, unlike all other types of RGCs. Recordings of UDs made by PhD student Ben Sivyer show that both On and Off visual stimuli elicit only inhibitory synaptic input. Researchers have found that this has the immediate effect of suppressing the firing and a delayed effect of increasing the amplitude of the renewed firing.

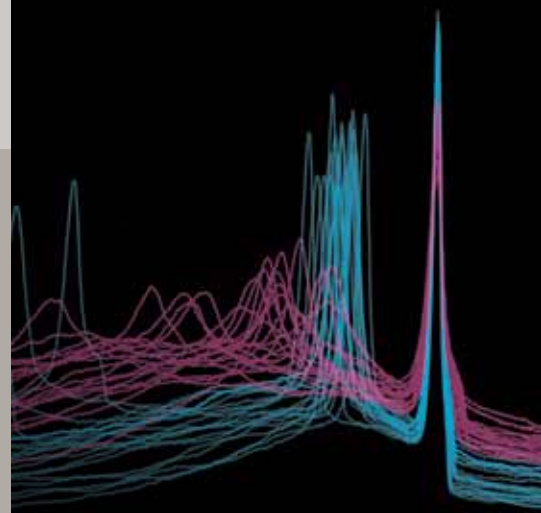
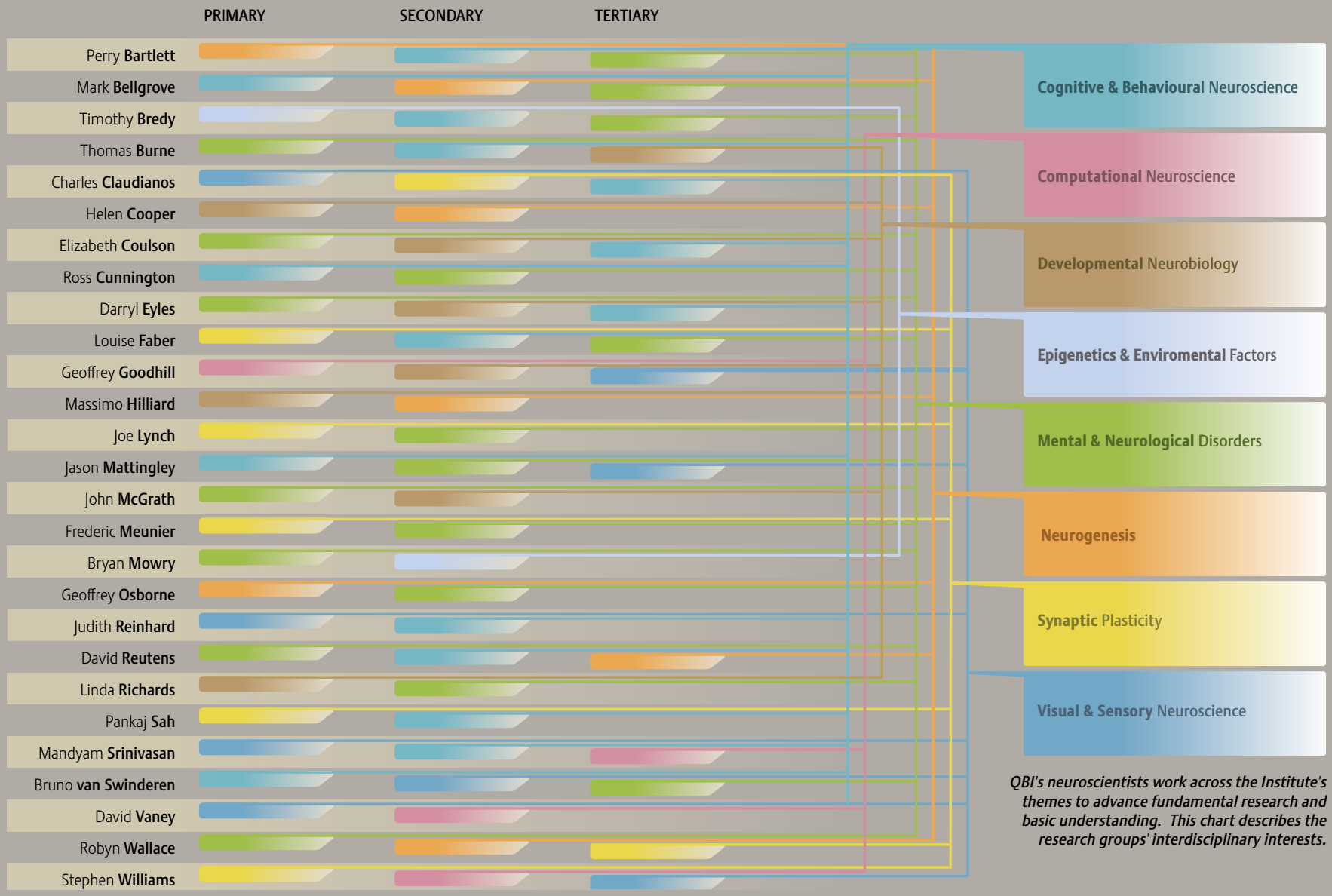


Image right: Firing of a uniformity detector.

Lab **members**

Refik Kanjhan
Nick Nacsa
Uli Siebeck
Ben Sivyer

Research **Themes**



QBI's neuroscientists work across the Institute's themes to advance fundamental research and basic understanding. This chart describes the research groups' interdisciplinary interests.

Community

Queensland Brain Institute neuroscientists are intrinsically linked to the communities in which they work and live. They regularly discuss the latest scientific discoveries with community groups, while also engaging with their peers at domestic and international conferences.

In 2009 the Queensland Brain Institute has hosted a number of renowned scientists at public lectures. However, Institute researchers do not only educate Australians affected by neurological disorders – they also challenge the next generation to consider a career in neuroscience.

Frontiers in Spinal Cord Research Conference

Spinal Frontier

Researchers from across the globe gathered at the Queensland Brain Institute in early September to discuss developments in spinal cord injury and repair research.

The Frontiers in Spinal Cord Research conference gave scientists the opportunity to learn more about evolving techniques in the areas of molecular studies, genetic and enzyme manipulations, stem cell transplantations, and techniques encouraging the return of damaged nerve pathways, pain management and exercise rehabilitation.

"Recently, great advances have been made in the science of spinal cord repair and, increasingly, such advances are finding their way from the laboratory to the clinic," QBI Director Professor Perry Bartlett said.

International speakers included Professors Hideyuki Okano (Keio University, Japan), John Steeves (University of British Columbia, Canada), John Kessler (Northwestern University, USA) and Alun Davies (Cardiff University, UK), Asst Professor Masaya Nakamura (Keio University, Japan) and Assoc. Professor Yaobo Liu (State Key Laboratory of Brain and Cognitive Science, China).

The conference was made possible through the generous support of its sponsors – SpinalCure Australia, Suncorp, Motor Accident Insurance Commission, Olympus, CSL and Australia New Zealand Spinal Cord Injury Network.

Short Course in Computational Neuroscience

The Smartest Computer

QBI was overwhelmed with applications for its annual Short Course in Computational Neuroscience, held in mid-February.

Designed to introduce maths, physics, engineering and computer science students to neuroscience, the unique course taught the next generation about brain modelling.

Course organiser and QBI computational neuroscientist Assoc. Professor Geoffrey Goodhill said there was an urgent need to entice students with a mathematical background to fundamental research.

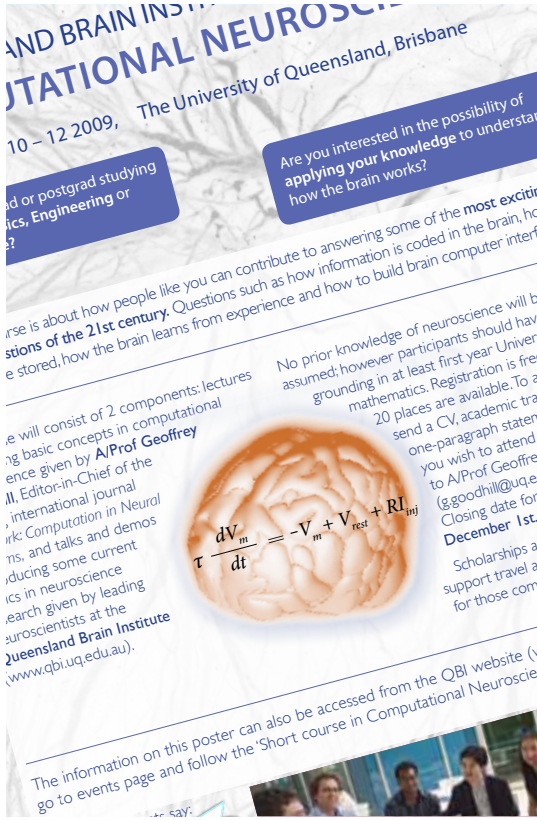
"Neuroscience is data rich but theory poor. We need to attract more people to the field who have the technical skills necessary to quantitatively analyse and model that data," he said.

The calibre of students interested in this year's course was extremely high, making it difficult for organisers to select attendees.

"We got more than twice as many applications as we could accommodate. Many of the students who were selected have won distinguished awards in their fields. They have a lot to offer to computational neuroscience and computational neuroscience has a lot of fascinating problems to offer them," explained Dr Goodhill.

Attendees learnt about the practical applications of computational neuroscience, such as improved therapies for restoring brain wiring after injury and better decoding algorithms for converting brain activity into instructions for moving prosthetic limbs. They also met with some of QBI's most eminent researchers.

"QBI's support of this course shows it is committed to bringing together researchers from the biological and more quantitative sciences," Dr Goodhill said.



QBI **Conferences**

Australia-China Workshop on Neuroscience and Cognition

Building Blocks

The Institute further strengthened its ties with collaborators at the Institute of Biophysics (IBP), Chinese Academy of Sciences at the Australia-China Workshop on Neuroscience and Cognition held at QBI in mid-May.

The Institutes are establishing a joint research laboratory in neuroscience and cognition, and the workshop provided an opportunity for investigators to discuss their collaborations and potential research partnerships.

QBI Director Professor Perry Bartlett said: "We have identified areas of mutual research strength. We are bringing together complementary expertise and advanced technologies in cellular and molecular systems to discover how functions like learning and memory are regulated, and to use these discoveries to develop new techniques to treat the avalanche of neurological and mental disease facing both countries."

UQ's Deputy Vice-Chancellor (Research) Professor Max Lu, Professor Bartlett and the Director of IBP's Centre for Brain and Cognitive Science Professor Ronqiao He opened the workshop, together with Mr Feng Xuan from the Chinese Embassy and Mr Brian Anker from the Queensland Department of Employment, Economic Development and Innovation.

The workshop was a reciprocal visit for the seven IBP neuroscientists who attended, after six QBI researchers visited IBP in Beijing in March 2009.

Corpus Callosum Development and Disorders Workshop

Addressing Developmental Disorders

The world's leading expert in corpus callosum malformation in children was a guest speaker at QBI's inaugural workshop on the subject in July.

Assoc. Professor Elliott Sherr, a paediatric neurologist from the University of California, San Francisco, spoke about the latest research into the corpus callosum, which connects the left and right sides of the brain. If the corpus callosum fails to form, a child can experience a range of symptoms including poor motor coordination, sensory deficits or social and learning difficulties.

Clinicians came from across Australia to hear the latest findings from researchers working in the field. Attendees also discussed forming an international alliance of clinicians and scientists working to develop diagnostic tests and treatments for children and adults with agenesis of the corpus callosum.

Further, Dr Sherr addressed families who have children affected by corpus callosum disorders at a public forum held during the workshop.

"The families took away some hope that at least people care about these disorders and are working hard on them. I think they were impressed at the level of commitment and detail it takes in scientific research to try and understand something as complicated as brain development," workshop organiser and QBI Assoc. Professor Linda Richards said.

In turn, the families gave researchers a rare insight into the impact of these disorders on day-to-day life.

"For the graduate students who work day and night on these disorders in the laboratory, but never see the people who are really affected, I think it was inspiring and put a human face to the disorders they work on," said Dr Richards.

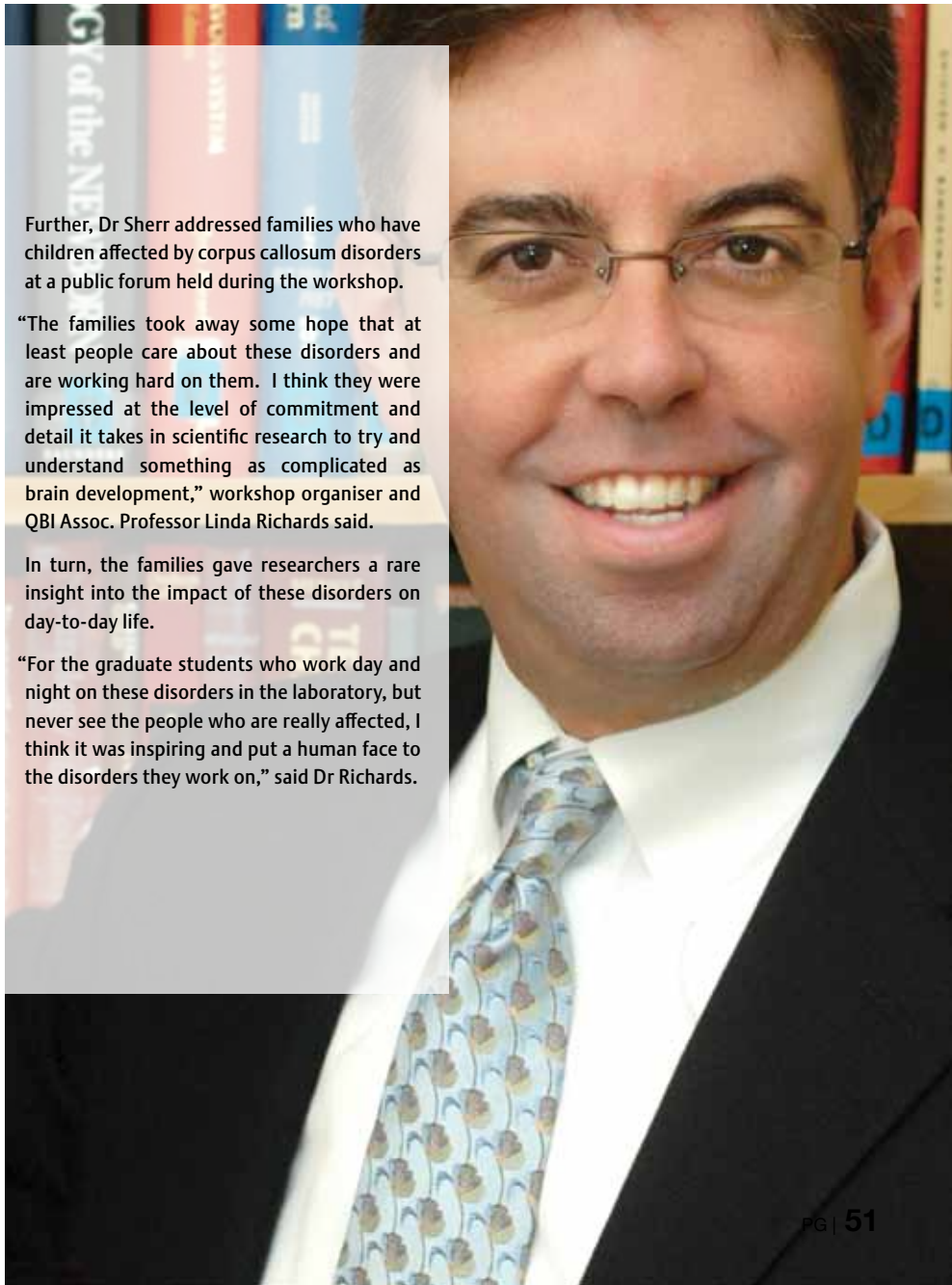


Image right: Assoc. Professor Elliott Sherr.

Merson Lecture

Mirror, Mirror

Almost 250 people packed the QBI Auditorium in early November for the inaugural Merson Lecture.

Named in honour of QBI Development Board Chair David Merson, the lecture is quickly becoming QBI's flagship event. As such, it was only fitting that world-renowned neuroscientist Professor Giacomo Rizzolatti, from the Universita` Degli Studi Di Parma, Italy, present the lecture on his groundbreaking research into how brain neurons respond to the actions of others.

Professor Rizzolatti has recorded the activity of nerve cells and how they react to hand actions. That led to the 1996 discovery that certain neurons could be activated when we copy – or mirror – someone else's actions.

"One of the most important things is understanding what other people are doing ... If someone grabs a beer I understand immediately what he is doing, I don't need to see him take it to his mouth," he said.

He has also found that autistic children are unable to mirror behaviour and are therefore unable to formulate other people's intentions in their mind.

"Their capacity to understand is not based on first person knowledge ... they don't understand immediately what is going on," he said.

Mr Merson applauded the researcher's work, which has spanned almost four decades. He said: "Malfunctions of the brain are by far the biggest and most costly health issue that we face as a community and as individuals."

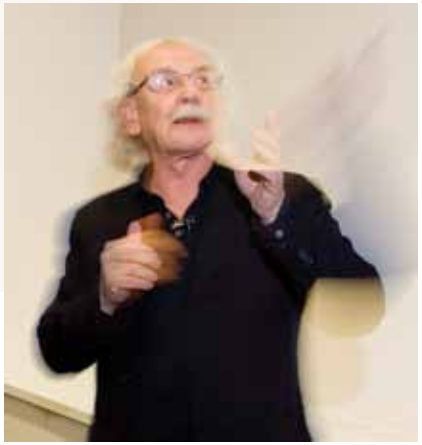


Image right: Professor Giacomo Rizzolatti presenting the inaugural Merson Lecture.

Peter Goodenough Memorial Lecture

Breaking the Silence

Mental and neurological disorders affect one in five Australians every year and yet a lack of understanding means the illnesses are often pushed under the carpet.

In August, Professor Harvey Whiteford from the Queensland Centre for Mental Health Research attempted to cut through the stigma by discussing the wider affects of mental illness on the community.

"Sixty four per cent of people who are going to develop a mental disorder will have their symptoms by the age of 21, so it strikes young people and disables them for long periods of time. That's where the big problems come," said the distinguished scientist, who was appointed to the World Bank's first mental health position in 1999.

Despite years of research, scientists still don't know what causes half of all mental illnesses. Professor Whiteford explained: "Even with our best treatments ... where money was no object, half the disease burden can't be averted because we can't cure these disorders.

"We seriously can do something to stop this. I believe the Queensland Brain Institute is part of the solution and what it can do in finding the causes of mental illness and providing us with better treatments is critically important."

Professor Whiteford was speaking at the annual Peter Goodenough Memorial Lecture. The lecture is named in honour of the late Peter Goodenough, whose personal battle with motor neuron disease led to a significant bequest for scientific research into the disease.

QBI **Events**

Toshiya Yamada Memorial Lecture

It Takes Spine

He is one of the world's leading neuroscientists and in March QBI was honoured to welcome Professor Martyn Goulding to discuss his research into spinal cord development.

Professor Goulding's lecture entitled *Going walkabout in the spinal cord: genetic approaches for unraveling the neural networks that control locomotion* provided the audience with a closer look at the circuits that control our everyday functions.

"These circuits allow us to do a range of things, such as coordinate movements that are required to play Australian Rules, paint a picture or play an instrument," he said.

Professor Goulding pioneered the use of mouse genetics in combination with traditional electrophysiological studies to reveal the identity of, and assign specific functions to, neural networks in the spinal cord. This work eventually changed the way scientists study spinal neural circuits.

During his lecture, the Salk Institute laboratory head also provided an insight into his latest research, which demonstrates how gene expression influences spinal cord development.

Professor Goulding was speaking at the annual Toshiya Yamada Memorial Lecture, held in honour of Dr Yamada who passed away in 2001.

Dr Yamada's discovery of the molecules essential for regulating the correct wiring of the spinal cord and parts of the brain forms much of the basis of modern neurobiology. His work was instrumental in the resurgence of Australia as a world leader in this field.

"If there's one lecture that I really wanted to give, this is the lecture ... The secret of the success that we've had stems from early work that Toshi did," Professor Goulding said.

Dr Yamada's family also attended the memorial lecture.

Meantime, QBI staff will be seeing much more of Professor Goulding in coming years. Since the Toshiya Yamada Memorial Lecture he has received a prestigious Australia Fellowship to take up a Faculty position at QBI. He will relocate his laboratory to the Institute in 2010.

Image behind Professor Martyn Goulding, right, credit: http://sites.uclouvain.be/nedi.

Eyes of the Law

It is a long way from keeping the streets safe to the laboratories at QBI – but that has not stopped the Queensland Police Minister taking an active interest in spinal cord injury research.

Minister Neil Roberts visited the Institute with QBI Development Board member and Police Commissioner Bob Atkinson in mid-November to learn more about treatments being developed to assist spinal injury patients.

They met with QBI Director Professor Perry Bartlett before touring the laboratory with Dr Mark Spanevello, who is part of the team researching therapeutic remedies.

"Currently there's no recovery from a spinal cord injury. Our research is leading to the possibility of regaining some sensation or movement that will improve the quality of life for sufferers of spinal cord injury," Professor Bartlett said.

The Minister was interested in details surrounding the research and told scientists: "You're now going through the practical issues ... but already it's really quite exciting stuff."

Dr Spanevello said clinical trials were at least 18 months away – and that was best-case scenario. "Any funding that will enable more trials and drug combinations, and decrease the time between the laboratory and the patient, will always provide better outcomes," he said.

Federal Focus

QBI was privileged to showcase its research to a number of federal Members of Parliament in 2009.

Professor Perry Bartlett gave each of the MPs a briefing on the work being carried out at the Institute before touring a selection of the research laboratories.

"It's important to get a first-hand look at the work being done here ... It's remarkable, innovative work that will impact so many people in society," Minister for Ageing, the Hon. Justine Elliot MP said.

Her December visit was preceded by a visit from Minister for Health and Ageing, the Hon. Nicola Roxon MP in July.

During Ms Roxon's visit she met with Drs Daniel Blackmore, Elizabeth Coulson, Dhanisha Jhaveri and Tara Walker to discuss their research into improving the understanding of the molecular mechanisms that regulate the production of neurons in the ageing brain.

Dr Jhaveri said: "It is remarkable to find that the machinery to generate new neurons is present in the ageing brain, albeit running at sub-optimal strength.

"We believe that the production of new neurons can be boosted by understanding the role of key players that we have begun to uncover, thus giving us hope of finding new ways to treat a variety of neurological disorders, particularly ageing dementia."

Professor Bartlett added: "The Ministers' visits were an opportunity for us to showcase QBI's strong record in fundamental research, work we anticipate will lead to advances in the treatment of conditions such as ageing dementia and Alzheimer's disease."

In all, 10 federal MPs visited the Institute in 2009, including President of the Senate John Hogg, Member for Moreton Graham Perrett and Queensland Senator Mark Furner.

Image above left: Queensland Police Minister Neil Roberts visits QBI's laboratories. Image above right: Assoc. Professor Bruno van Swinderen shows Federal Minister for Ageing Justine Elliot his research laboratory.

Commercial **Enterprise**

Although it is only six years old, QBI is rapidly developing a diverse patent portfolio extending from novel therapeutic treatments for neurological disorders to software for generating maps. The Institute and its researchers are continually working with the Innovation and Commercial Development Manager to develop products which will ultimately lead to advances that benefit all of society.

2009 got off to a flying start with UniQuest Pty Ltd signing an exclusive licence with CSL Ltd for a spinal cord injury therapeutic, which was developed by QBI Director Professor Perry Bartlett in collaboration with colleagues at the University of Melbourne and the Queensland Institute of Medical Research. The treatment will promote the regrowth of axons in the spinal cord following injury and QBI is continuing to collaborate with CSL in the development of this potentially revolutionary therapeutic.

In July, QBI signed a Collaborative Research and Commercialisation Agreement with Biolink for the development of therapeutics for the prevention and treatment of botulism toxin. This agreement stemmed from the research of Assoc. Professor Frederic Meunier, who heads the neuronal trafficking laboratory at the Institute.

QBI's commercialisation efforts received a significant boost with the appointment of Smart State Entrepreneur-In-Residence, Professor David Gearing. His primary role is to work with researchers and the Innovation and Commercial Development Manager to implement strategies that facilitate the rapid transfer of early discovery research to the clinic, while at the same time adding maximum value to the finding.

In the future, the Commercial Enterprise team will continue its efforts to attract and develop relationships with commercial partners for QBI's research into brain disorders, flight control, navigation and mapping technologies, and odour detection.

The Institute will also continue its strategic relationship with UniQuest, the main commercialisation company of The University of Queensland, which provides access to commercialisation expertise, processes and resources, and is recognised as an Australian leader in the field.

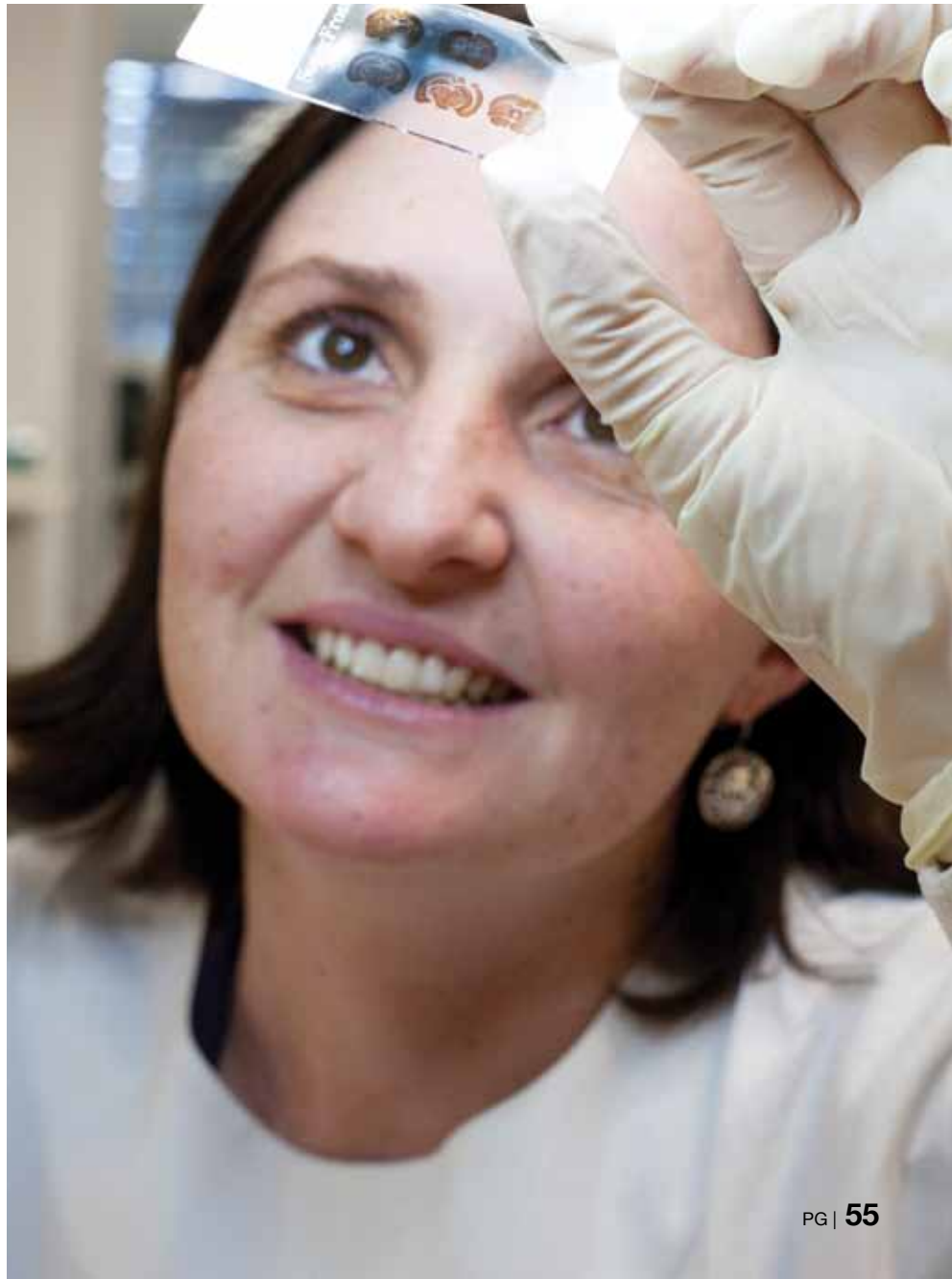


Image right: Research assistant Petra Sedlak at work in the laboratory.

Community **Outreach**

QBI's community outreach program is designed to engage people interested in discovering more about neurological disorders. The program's success is proof of the public's thirst to learn more about the latest developments in this area of research.

In addition to regular tours through QBI's world-class facilities, the Institute's researchers frequently conduct lectures, talks and discussions that are the anchor of the outreach program. This interaction – in libraries, bookstores, schools, hospitals and other community settings across the country – has continually proven beneficial for the public and scientists alike.

As the community learns more about the world-leading research being conducted at QBI, the lectures provide an unparalleled opportunity for scientists to meet people who, in many cases, know someone affected by a neurological condition. Engaging with people who will potentially benefit from QBI's research in the longer term provides an additional impetus for the neuroscientists to advance their work.

In 2009 QBI's researchers were involved in more than 30 public speaking engagements, including:

QBI Director Professor Perry Bartlett contributed to the panel discussion 'Queensland in 50 years' at the Brisbane Institute

Professor John McGrath delivered a talk on mental health at a Rotary Brisbane City meeting

Dr Elizabeth Coulson addressed clinical staff during a Grand Round session at the Prince Charles Hospital

Dr Darryl Eyles briefed members of the Association of Relatives and Friends of the Mentally Ill (ARAFMI) Sunshine Coast and the Ipswich Hospital Foundation on schizophrenia research

Dr Robyn Wallace updated members of the Souths Rugby Club on the latest motor neuron disease research

Dr Adam Hamlin delivered a talk on dementia and brain awareness at the Logan West Library

Dr Guy Barry spoke to members of the Emu Park Lions Club (near Rockhampton) as part of the Queensland Government's Talking Scientists program

Image right: James Kesby (PhD student in the Eyles laboratory) talking to members of ARAFMI Sunshine Coast.

Australia New Zealand **Brain Bee Challenge**

out-smart, out-think, out-last

The Australian Brain Bee Challenge (ABBC) was established in 2006 to encourage and inspire high school students to pursue an interest in neuroscience. With neurological and mental illness accounting for up to 45 per cent of the disease burden in Australia, QBI is committed to attracting the best young minds to careers in research.

In 2009 the ABBC continued to build on its success from previous years. More than 2,600 Year 10 students completed the competition in Australia and another 685 Year 11 students took part in New Zealand, taking the total number of participants to date to more than 7,000 and 1,500 respectively.

In Queensland, over 100 state finalists made their way to QBI in July, where they were given the rare opportunity to tour the Institute and meet researchers. For most students it was their first time inside a neuroscience facility – and for many it was enough to whet their appetite in what is often called the 'final frontier' of science.

The 2009 Queensland winner was Millie MacDonald from Cleveland District State High School. Millie will take part in the national finals in January 2010, where she will vie for a place in the International Brain Bee finals in California.

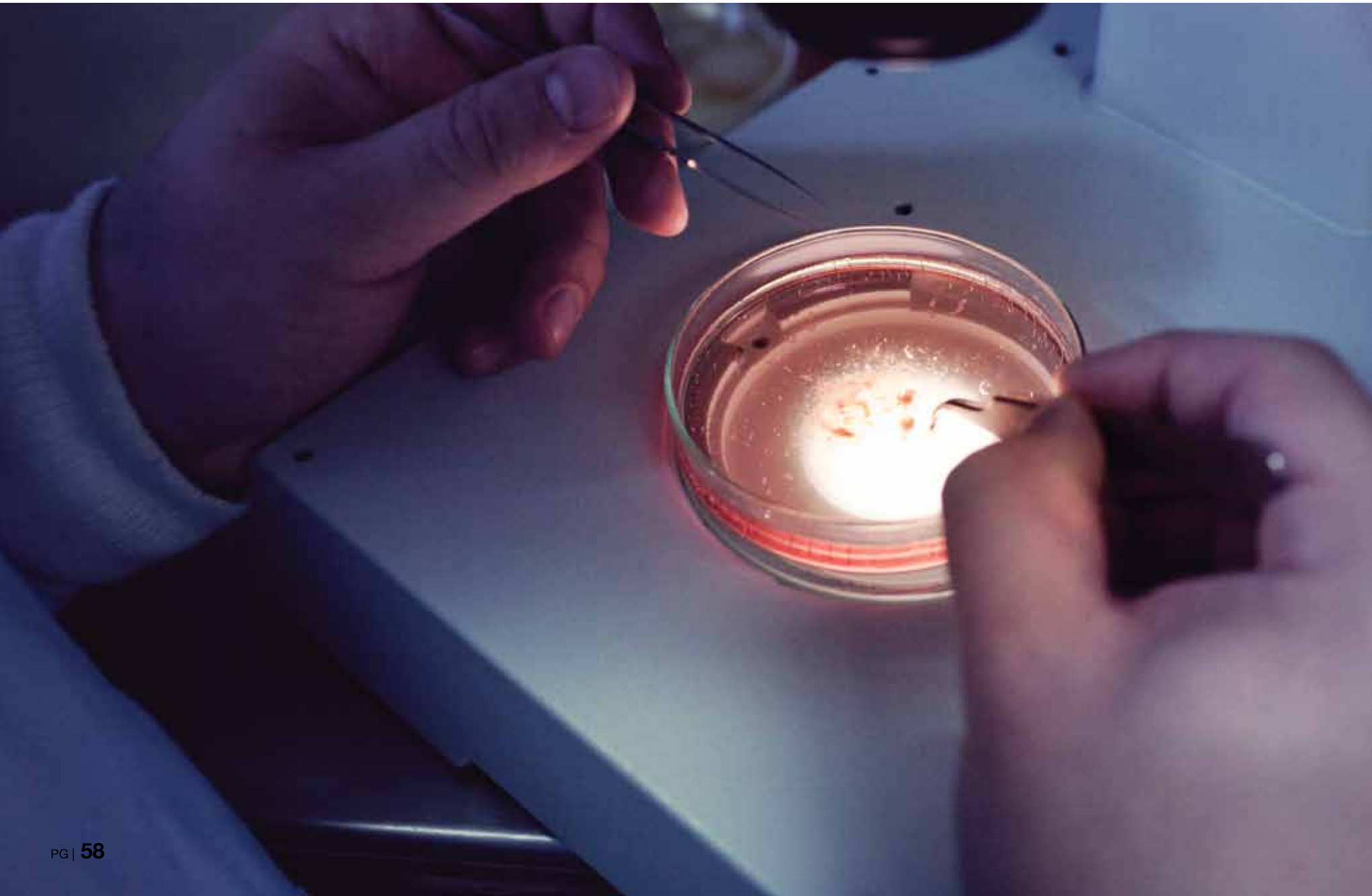
Meanwhile, 2008 Queensland winner Casey Linton represented Australia in the international finals and came a highly commendable second.

As well as winning their places in the national finals, the brightest Queensland students are given the opportunity to undertake work experience at QBI, with 15 ABBC alumni already choosing to take up the offer. 2007 alumnus Sophie Hill now works part-time at the Institute and was awarded the Queensland Government's 2009 Smart Women-Smart State Award – Secondary School Students Category for her research into the neural regenerative capacity of the mouse brain, which will improve understanding of how the human brain works.

Results such as this demonstrate that the ABBC is achieving its goals of stimulating and supporting students' fascination with science, and encouraging their continued interest throughout their higher education and careers.

Images left and above: 2009 State Finalists mingle with Brain Bee alumni.

Recognition



Recognition

Queensland Brain Institute researchers consistently shine in the neuroscience community and represent the Institute on a number of pivotal scientific organisations and editorial boards. In 2009 more than half of the Institute's Australian Research Council and National Health and Medical Research Council submissions were successful and researchers authored more publications than ever before.

Finally, research and discovery would not be possible without the generosity of donors – for whom the Queensland Brain Institute is continually grateful.

Fellowships and Awards

Hats off to Graduates

The first students to complete their PhDs through the Queensland Brain Institute graduated from The University of Queensland at the end of 2009 – and already they are standing out from the crowd.

Dr Adrian Carter completed his PhD, entitled *Addiction neuroethics: the promises and perils of neuroscience research on addiction*, under the supervision of Professors Wayne Hall and Perry Bartlett. His thesis caught the attention of UQ Graduate School Dean Professor Zlatko Skrbis, who awarded him the 2009 Dean's Award for Outstanding Research Higher Degree Theses.

Professor Skrbis said: "The thesis was among the small number that received assessors reports attesting to the outstanding quality and exceptionally innovative nature of the research described in the thesis. Fewer than 10 per cent of PhD and MPhil graduates are recognised this way each year."

Dr Carter is continuing his research at UQ's School of Population Health.

Meantime, fellow graduate Dr Duncan Mortimer received his PhD for research applying the mathematical framework Bayesian decision theory to the development of the nervous system under Assoc. Professor Geoffrey Goodhill.

"It's been very interesting seeing the Institute develop from the inside – from the early days in the Ritchie Building to moving into the spectacular new facility," Dr Mortimer said.

"I've really enjoyed being a part of this developing Institute and I'm looking forward to seeing new discoveries at QBI in the future."

He said he hoped to further his studies as a postdoctoral researcher in a computational neuroscience laboratory overseas.

Tall Poppy continues to Bloom

Developmental neuroscientist Dr Michael Piper wrapped up an impressive year when he was honoured as a finalist in the 2009 Queensland Young Tall Poppy Scientist of the Year awards.

Dr Piper is currently studying the genes that regulate stem cell differentiation in embryonic brains, as these are crucial in enabling the correct proportion of neuronal and glial cells within the brain to develop.

"This is important both on a pure research level – trying to understand how this developmental process occurs – but also looking forward to the adult, as new neurons develop throughout our lives," he said.

The Tall Poppy Awards recognise researchers based on their scientific achievements and willingness to promote their discipline in the community.

"One of the benefits of being in the finals is I will get the chance to go to various schools to talk to students and really be involved in spreading the good word of science," said Dr Piper.

This follows on from Dr Piper receiving the Australian Neuroscience Society's 2009 AW Campbell Award for the best contribution by a Society member in their first five postdoctorate years and an NHMRC Career Development Award for 2009 – 2012.

His supervisor Assoc. Professor Linda Richards commented: "Dr Piper has received a number of awards in the past year, which is a testament to his productivity and the outstanding potential he has shown as an early career researcher."

Image left: Dr Duncan Mortimer. Image right: Dr Michael Piper.

Fellowships and Awards

Smart Research gets Smart Funding

Assoc. Professor Helen Cooper's research developing innovative treatments for neuro-degenerative diseases received a boost in July when she was awarded a Queensland Government Smart Futures Fellowship.

The three-year $300,000 funding will enable her to research layered double hydroxide (LDH) nanoparticles as an effective drug delivery system for the treatment of neuro-degenerative diseases. LDH particles consist of positively charged layers that have a high drug-carrying capacity.

This nanoparticle technology will be used to create a novel drug delivery system that will efficiently carry drugs into the brain to target the production of mutant proteins within neurons damaged by Alzheimer's and Huntington's diseases.

Meantime, PhD student Ajay Panwar was awarded a Smart Futures PhD scholarship for his studies into the biological markers of motor neuron disease (MND) in both human patients and mouse models. This research, being conducted in Dr Robyn Wallace's laboratory, is advancing understanding of what causes MND and has highlighted potential targets for drug development.

QBI Researcher grabs Judges' Attention

Leading cognitive neuroscientist Assoc. Professor Mark Bellgrove won the 2009 Paul Bourke Award for Early Career Research for his investigations into attention deficit hyperactivity disorder (ADHD).

The Award, from the Academy of the Social Sciences in Australia, recognises Dr Bellgrove's research into the links between cognitive problems and the genes for ADHD.

"Problems inhibiting behaviour are a major feature of a lot of psychiatric disorders. People with ADHD have trouble inhibiting behaviour – for example, children often blurt out answers in class at inappropriate times and just can't exercise cognitive control," Dr Bellgrove explained.

He is currently leading one of the largest Australian studies into ADHD in an effort to identify the genes that confer risk to the disorder.

Dr Bellgrove is also investigating the effects of certain chemicals, such as dopamine and noradrenaline, on the ability to inhibit behaviour. Eventually, this research could lead to clinicians better diagnosing patients and providing more targeted treatments.

Image right: Assoc. Professor Mark Bellgrove in consultation with a patient.

Grants

In 2009 grants at the Queensland Brain Institute totalled $24,164,235. These pages include national and international competitive, external grants only – UQ grants are not listed.

Alzheimer's Australia Research
Dementia Research Grants Program

Sykes A, Coulson E (2009) The detection and inhibition of p75 neurotrophin receptor-mediated neurodegeneration $19,931

Århus University Forskningsfond

E Coulson, A Nyjkaer (2009) Regulation of neuronal death signaling in Alzheimer's disease DKr 149,875 ~$35,000

Australian Research Council

ARC Discovery Projects

Meunier F, Lavidis N (2009-2011) Sustaining neuronal communication through bulk endocytosis $270,000

Richards L (2009-2013) Specialized glial cells within the hippocampus of the brain regulate important morphological events in embryonic development $760,000

Rietze R, Waters M (2009-2011) Identifying the pathways employed by growth hormone to regulate the proliferation of adult neural stem cells $480,000 [This funding was transferred to M Waters, UQ because Chief Investigator R Rietze relocated overseas]

ARC Future Fellowship

Cunnington R (2010-2014) The human mirror system and the perception of others' actions $788,800 [awarded in 2009, commenced in 2010]

Australian Stem Cell Centre – Research Program

Bartlett P (2009-2011) Australian Stem Cell Collaborative Stream 4 - Module 3: Endogenous neural stem cells: function and regulation $404,569

Bill and Melinda Gates Foundation
Grand Challenges Explorations

Vegh V, Pierens G, Reutens D, Wang D (2009) Detection of malaria using low cost/field MRI spectroscopy $109,850

Bioplatforms Australia

Piper M (2009) Bioplatforms Australia $10,000

Commonwealth of Australia,
Department of Health and Ageing

Morgan V, Jablensky A, Waterreus A, Bush R, **McGrath J**, Harvey C, McGorry P, Castle D, Cohen M, Stain H, Galletly C, MacKinnon A (2009-2011) National survey of high impact psychosis (SHIP) $6,155,513 [This grant was awarded to the University of Western Australia and partly administered by UQ]

Eli Lilly Investigator Initiated Trial

Bellgrove M (2009) Physiological effects of atomoxetine on attentional lapses in adults with ADHD $49,410

Golden Casket Foundation
Research Equipment Grant

Mattingley J, Cunnington R, Hester R, McMahon K, de Zubicaray G, Galloway G, **Bellgrove M**, Lipp O (2009) Stimulus delivery and response recording system, eye-monitoring system, and motion capture system for recording limb movements $220,745

Motor Neurone Disease Research
Institute of Australia

Wallace R, McCombe P, **Osborne G**, Hendersen R (2009) Identifying biomarkers for MND using flow cytometry $35,000

Multiple Sclerosis Research Australia

McCombe P, Greer J, **Wallace R** (2009-2011) The effects of pregnancy and the post-partum period on T cells, antibodies and gene expression in EAE $285,000 [This grant was awarded to and administered by UQ's Centre for Clinical Research]

National Health and Medical Research Council

NHMRC Career Development Award

Bellgrove M (2009-2012) Attention deficit hyperactivity disorder (ADHD): genes cognition and brain activity $409,000

Coulson E (2009-2013) Molecular mechanisms of neural survival $409,000

Piper M (2009-2013) Nfi genes regulate the switch between neurogenesis and gliogenesis during cortical development $370,000

NHMRC Program Grant

Bartlett P, Tan S-S, Kilpatrick T, **Sah P** (2009-2013) Development and refinement of neural connections in the adult brain in health and disease $7,627,200

NHMRC Project Grants

Bartlett P, Boyd A, **Sah P** (2009-2011) Regulation and function of a latent hippocampal precursor population $760,500 [This funding was relinquished in order to accept the NHMRC Program Grant awarded to P Bartlett for 2009]

Bellgrove M, Cunnington R, Vance A, Heussler H (2009-2011) Imaging genetics of attention deficit hyperactivity disorder (ADHD) $309,250

Bellgrove M, Hester R, **Mattingley J,** Nathan P (2009-2011) Physiological and neurochemical mechanisms of executive control $274,250

Bellgrove M, Mattingley J, Vance A, Hay D, Heussler H, **Wallace R**, Neilson N (2009-2011) The genetics of cognitive deficits in attention deficit hyperactivity disorder (ADHD) $648,750

Cooper H, Reynolds B (2009-2011) Neogenin regulates progenitor division and interneuron migration in the developing forebrain $506,250

Coulson E (2009-2011) Aβ-induced cell death signalling by the p75 neurotrophin receptor $607,500

Harding A, Reynolds B, Gabrielli B (2009-2011) The role of tumour-initiating cells in glioma $349,500

Hilliard M (2009-2011) Axonal degeneration in *C. elegans* $491,250

Ibbotson M, **Goodhill G** (2009-2011) Measuring and modeling visual cortical plasticity $468,750 [This grant was awarded to and is administered by the Australian National University]

Kilpatrick T, Cate H, Tan S–S, **Bartlett P** (2009-2011) The role of NDFIP1 in neural stem cell survival and their generation into neurons $486,500 [This grant was awarded to the Howard Florey Institute and was relinquished in order to accept the NHMRC Program Grant awarded to P Bartlett for 2009]

Grants

McGrath J, Eyles D, Burne T, Whitelaw E (2009-2011) Advanced paternal age: behavioural neuroanatomical and genomic correlates in the offspring of older fathers $481,250

Power J (2009-2011) Modulation of calcium signalling by acetylcholine in the basolateral amygdala $255,000

Richards L (2009-2011) Nuclear Factor One genes regulate multiple aspects of cerebral cortex development $506,250

Sah P, Bartlett P (2009-2011) Integration and function of newborn neurons in the adult amygdala $538,500 [This funding was relinquished in order to accept the NHMRC Program Grant awarded to P Bartlett for 2009]

NHMRC Research Fellowships

Lynch J (2009-2013) NHMRC Senior Research Fellowship Level B $618,750

Meunier F (2009-2013) NHMRC Research Fellowship Level A $560,000

NHMRC Training Fellowship

Hamlin A (2009-2013) The role of p75 neurotrophin receptor-mediated neurodegeneration of basal forebrain cholinergic neurons $285,000

National Institutes of Health (USA)

NIH - Go Grant RFA sub-award

Bellgrove M (2009-2010) Genomewide SNP and CNV scan of attention deficit hyperactivity disorder $4,320

NIH - National Institute of Neurological Disorders and Stroke (NINDS) sub-award

Hilliard M (2009-2012) Femtosecond laser axotomy for *in vivo* nerve regeneration studies in *C. elegans* $266,745 [Subaward of funding awarded to Ben-Yakar A: University of Texas at Austin (Chief Investigator) Hall, D Alert Heinstein College of Medicine, USA (Chief Investigator)]

Queensland Health

Mowry B (2009) QCMHR Operational (Genetics Laboratory Program Funding) $115,000 [Funds transferred to QBI in 2009]

Queensland State Government Entrepreneur-in-Residence Fellowship

Gearing D (2009-2010) Commercialising Queensland Brain Institute projects $133,000

Queensland State Government National and International Research Alliance Program

Smith M, **Coulson E**, Kindy S, Rose S, Brereton I, Chalk J, Whittaker A (2009-2012) Alzheimer's disease: MRI biomarkers $1,619,082 [This funding was awarded to and is administered by TetraQ, UQ]

Queensland State Government Smart Futures Fellowship

Cooper H (2009-2011) Development of LDH nanoparticles as an effective drug delivery system for the treatment of neurodegenerative diseases $300,000

Breakdown of QBI's grant funding in 2009

Publications

Astuti P, Pike T, Widberg C, Payne E, **Harding A**, Hancock J, Gabrielli B (2009) MAPK pathway activation delays G_2/M progression by destabilising Cdc25B. *Journal of Biological Chemistry* 284: 33781-33788.

Badrick AC, **Jones CE** (2009) The amyloidogenic region of the human prion protein contains a high affinity $(Met)_2(His)_2$ Cu(I) binding site. *Journal of Inorganic Biochemistry* 103: 1169-1175.

Baumann O, Chan E, Mattingley JB (2009) Dissociable neural circuits for encoding and retrieval of object locations during active navigation in humans. *Neuroimage* 49: 2816-2825.

Baumann O, Greenlee MW (2009) Effects of attention to auditory motion on cortical activations during smooth pursuit eye tracking. *PLoS ONE* 4: e7110.

Beare R, Srikanth V, Chen J, Phan TG, Stapleton J, Lipshut R, **Reutens D** (2009) Development and validation of morphological segmentation of age-related cerebral white matter hyper-intensities. *Neuroimage* 47: 199-203.

Bellgrove MA, Johnson KA, Barry E, Mulligan A, Hawi Z, Gill M, Robertson I, Chambers CD (2009) Dopaminergic haplotype as a predictor of spatial inattention in children with attention-deficit/hyperactivity disorder. *Archives of General Psychiatry* 66: 1135-1142.

Berecki G, Motin L, Haythornthwaite A, Vink S, Bansal P, Drinkwater R, Wang CI, Moretta M, Lewis RJ, Alewood PF, Christie MJ, **Adams DJ** (2009) Analgesic ω-conotoxins CVIE and and CVIF selectively and voltage dependently block recombinant and native N-type calcium channels. *Molecular Pharmacology* 77: 139-148.

Bhagavatula P, Claudianos C, Ibbotson M, **Srinivasan M** (2009) Edge detection in landing budgerigars (*Melopsittacus undulatus*). *PLoS ONE* 4: e7301.

Blackmore DG, Golmohammadi MG, Large B, Waters MJ, **Rietze RL** (2009) Exercise increases neural stem cell number in a GH-dependent manner, augmenting the regenerative response in aged mice. *Stem Cells* 27: 2044-2052.

Bortoletto M, Cunnington R (2009) Motor timing and motor sequencing contribute differently to the preparation for voluntary movement. *Neuroimage* 49: 3338-3348.

Braet W, Johnson KA, Tobin CT, Acheson R, **Bellgrove MA**, Robertson IH, Garavan H (2009) Functional developmental changes underlying response inhibition and error-detection processes. *Neuropsychologia* 47: 3143-3151.

Carter A, Hall W, Capps B (2009) What is addiction? *Addiction Neurobiology: Ethical and Social Implications* eds. Carter A, Capps B, Hall W. Lisbon Portugal 21-26.

Carter A, Hall W, Nutt D (2009) The neurobiology of addiction. *Addiction Neurobiology: Ethical and Social Implications* eds. Carter A, Capps B, Hall W. Lisbon Portugal 29-50.

Carter A, Hall W, Nutt D (2009) The treatment of addiction. *Addiction Neurobiology: Ethical and Social Implications* eds. Carter A, Capps B, Hall W. Lisbon Portugal 53-68.

Carter A, Hall W, Capps B, ter Meulen R (2009) New developmments in the treatment of addiction. *Addiction Neurobiology: Ethical and Social Implications* eds. Carter A, Capps B, Hall W. Lisbon Portugal 85-120.

Capps B, **Carter A**, Hall W, Nutt D, Ashcroft R, ter Meulen R (2009) Conclusions and possible implications of advances in addiction neurobiology for future drug policies. *Addiction Neurobiology: Ethical and Social Implications* eds. Carter A, Capps B, Hall W. Lisbon Portugal 123-128.

Chan E, Mattingley JB, Huang-Pollock C, English T, **Hester R**, Vance A, **Bellgrove MA** (2009) Abnormal spatial asymmetry of selective attention in ADHD. *Journal of Child Psychology and Psychiatry* 50: 1064-1072.

Chen AP, **Muller CC, Cooper HM**, Williams CM (2009) Total synthesis of (±)-4,5-Bis-epi-Neovibsanin A and B: A neurite outgrowth comparison study. *Organic Letters* 11: 3758–3761.

Chen X, Cromer BA, **Lynch JW** (2009) Molecular determinants of β-carboline inhibition of the glycine receptor. *Journal of Neurochemistry* 110: 1685 – 1694.

Chen X, Webb TI, Lynch JW (2009) The M4 transmembrane segment contributes to agonist efficacy differences between α1 and α3 glycine receptors. *Molecular Membrane Biology* 26: 321-332.

Cheung A (2009) Mathematical and neural network models of medium-range navigation during social insect foraging. In *Food Exploitation by Social Insects: Ecological, Behavioral, and Theoretical Approaches* eds. Jarau S, Hrncir M, Boca Raton, United States of America CRC Press 293-322.

Coelho CM, Waters AM, Hine TJ, **Wallis G** (2009) The use of virtual reality in acrophobia research and treatment. *Journal of Anxiety Disorders* 23: 563-574.

Colditz MJ, Catts VS, Al-Menhali N, Osborne GW, Bartlett PF, Coulson EJ (2009) p75 neurotrophin receptor regulates basal and fluoxetine-stimulated hippocampal neurogenesis. *Experimental Brain Research* 200: 161-167.

Coulson EJ, May LM, Sykes AM, Hamlin AS (2009) The role of the p75 neurotrophin receptor in cholinergic dysfunction in Alzheimer's disease. *Neuroscientist* 15: 317-323.

Crane JW, Baiquni GP, **Sullivan R**K, Lee JD, **Sah P**, Taylor SM, **Noakes PG**, Woodruff TM (2009) The C5a anaphylatoxin receptor CD88 is expressed in presynaptic terminals of hippocampal mossy fibres. *Journal of Neuroinflammation* 6: 1-10.

Crane JW, Windels F, Sah P (2009) Oscillations in the basolateral amygdala: aversive stimulation is state dependent and resets the oscillatory phase. *Journal of Neurophysiology* 102: 1379–1387.

Cummins SF, Erpenbeck D, Zou Z, **Claudianos C**, Moroz LL, Nagle GT, Degnan BM (2009) Candidate chemoreceptor subfamilies differentially expressed in the chemosensory organs of the mollusc *Aplysia*. *BMC Biology* 7: 1-20.

Degenhardt L, Hall WD, Lynskey M, **McGrath J**, McLaren J, Calabria B, Whiteford H, Vos T (2009) Should burden of disease estimates include cannabis use as a risk factor for psychosis? *PLoS Medicine* 6: e1000133.

Publications

Delaney AJ, **Esmaeili A**, **Sedlak PL, Lynch JW, Sah P** (2009) Differential expression of glycine receptor subunits in the rat basolateral and central amygdala. *Neuroscience Letters* 469: 237-242.

Deleyrolle LP, Reynolds BA (2009) Isolation, expansion, and differentiation of adult mammalian neural stem and progenitor cells using the neurosphere assay. *Methods in Molecular Biology* 549:91-101.

Dibbens LM, Michelucci R, Gambardella A, Andermann F, Rubboli G, Bayly MA, Joensuu T, Vears DF, Franceschetti S, Canafoglia L, **Wallace R**, Bassuk AG, Power DA, Tassinari CA, Andermann E, Lehesjoki AE, Berkovic SF (2009) SCARB2 mutations in progressive myoclonus epilepsy (PME) without renal failure. *Annals of Neurology* 66: 532-536.

Donahoo AL, Richards LJ (2009) Understanding the mechanisms of callosal development through the use of transgenic mouse models. *Seminars in Pediatric Neurology* 16: 127-142.

Eldi P, **Rietze RL** (2009) Flow cytometric characterization of neural precursor cells and their progeny. *Methods in Molecular Biology* 549:77-89.

Enticott PG, Bradshaw JL, **Bellgrove MA**, Upton DJ, Ogloff JR (2009) Stop task after-effects. The extent of slowing during the preparation and execution of movement. *Experimental Psychology* 56: 247-251.

Evangelista C, Kraft P, Dacke M**, Reinhard J, Srinivasan MV** (2009) The moment before touchdown: landing manoeuvres of the honeybee *Apis lemmifera*. *Journal of Experimental Biology* 213: 262-270.

Eyles D, Anderson C, Ko P, Jones A, Thomas A, **Burne T**, Mortensen PB, Norgaard-Pedersen B, Hougaard DM, **McGrath J** (2009) A sensitive LC/MS/MS assay of 25OH vitamin D_2 and 25OH vitamin D_3 in dried blood spots. *Clinica Chimica Acta* 403: 145-151.

Eyles DW, Cui X, Kesby JP, Harms LH, Ko P, McGrath JJ, Burne THJ (2009) Developmental vitamin D deficiency causes abnormal brain development. *Psychoneuroendocrinology* 34: S247-S257.

Faber ESL (2009) Functions and modulation of neuronal SK channels. *Cell Biochemistry and Biophysics* 55: 127-139.

Faber ESL (2009) Synaptic plasticity in the medial prefrontal cortex. In *Synaptic Plasticity: New Research*, eds. Kaiser TF, Peters FJ. Nova Publishers 221-268.

Fernandes de Abreu DA, **Eyles D**, Féron F (2009) Vitamin D, a neuro-immunomodulator: implications for neurodegenerative and autoimmune diseases. *Psychoneuroendocrinology* 34 Suppl 1: S265-S277.

Gilbert DF, Esmaeili A, Lynch JW (2009) Optimizing the expression of recombinant αβγ $GABA_A$ receptors in HEK293 cells for high throughput screening. *Journal of Biomolecular Screening* 14: 86-91.

Gilbert DF, Islam R, Lynagh TP, Lynch JW, **Webb TI** (2009) High throughput techniques for discovering new glycine receptor modulators and their binding sites. *Frontiers in Molecular Neuroscience* 2: 1-10.

Gilbert DF, Wilson JC, Nink V, Lynch JW, Osborne GW (2009) Multiplexed labeling of viable cells for high throughput analysis of glycine receptor function using flow cytometry. *Cytometry Part A* 75: 440-449.

Haines C, Goodhill GJ (2010) Analyzing neurite outgrowth from explants by fitting ellipses. *Journal of Neuroscience Methods* 187: 52-58.

Halai R, Clark RJ, **Nevin ST**, Jensen JE, **Adams DJ**, Craik DJ (2009) Scanning mutagenesis of α-conotoxin Vc1.1 reveals residues crucial for activity at the α9α10 nicotinic acetylcholine receptor. *Journal of Biological Chemistry* 284: 20275–20284.

Han L, Jiang T, Han GA, **Malintan NT**, Xie L, Wang L, Tse FW, Gaisano HY, Collins BM, **Meunier FA**, Sugita S (2009) Rescue of Munc18-1 and -2 double knockdown reveals the essential functions of interaction between Munc18 and closed syntaxin in PC12 cells. *Molecular Biology of the Cell* 20: 4962-4975.

Harvey L, Burne THJ, Cui X, Mackay-Sim A, **Eyles D, McGrath J** (2009) Vitamin D and the brain: a neuropsychiatric perspective. *Clinical Reviews in Bone and Mineral Metabolism* 7: 199-205.

Hester R, Madeley J, Murphy K, **Mattingley JB** (2009) Learning from errors: error-related neural activity predicts improvements in future inhibitory control performance. *Journal of Neuroscience* 29: 7158-7165.

Hofmann CM, O'Quin KE, **Marshall NJ**, Carleton KL (2009) The relationship between lens transmission and opsin gene expression in cichlids from Lake Malawi. *Vision Research* doi:10.1016/j.visres.2009.12.004.

Holliday EG, McLean DE, Nyholt DR, **Mowry BJ** (2009) Susceptibility locus on chromosome 1q23-25 for a schizophrenia subtype resembling deficit schizophrenia identified by latent class analysis. *Archives of General Psychiatry* 66: 1058-1067.

Huang H, Xue R, Zhang J, Ren T, **Richards LJ**, Yarowsky P, Miller MI, Mori S (2009) Anatomical characterization of human fetal brain development with diffusion tensor magnetic resonance imaging. *Journal of Neuroscience* 29: 4263-4273.

Hunt JJ, **Giacomantonio CE, Tang H, Mortimer D**, Jaffer S, Vorobyov V, **Ericksson G**, Sengpiel F, **Goodhill GJ** (2009) Natural scene statistics and the structure of orientation maps in the visual cortex. *Neuroimage* 47: 157-172.

Irvine DRF, Brown M, **Kamke MR**, Rubel EW (2009) Effects of restricted basilar papillar lesions and hair cell regeneration on auditory forebrain frequency organization in adult European starlings. *Journal of Neuroscience* 29: 6871-6882.

Jensen JE, Durek T, Alewood PF, **Adams DJ**, King GF, Rash LD (2009) Chemical synthesis and folding of APETx2, a potent and selective inhibitor of acid sensing ion channel 3. *Toxicon* 54: 56-61.

Kesby JP, Cui X, Ko P, McGrath JJ, Burne THJ, Eyles DW (2009) Developmental vitamin D deficiency alters dopamine turnover in neonatal rat forebrain. *Neuroscience Letters* 461: 155-158.

Kesby JP, Cui X, O'Loan J, **McGrath JJ, Burne TH, Eyles DW** (2009) Developmental vitamin D deficiency alters dopamine-mediated behaviors and dopamine transporter function in adult female rats. *Psychopharmacology* 208: 159-168.

Kim JH, **Hamlin AS**, Richardson R (2009) Fear extinction across development: the involvement of the medial prefrontal cortex as assessed by temporary inactivation and immunohistochemistry. *Journal of Neuroscience 29*: 10802-10808.

Laffaire J, Rivals I, Dauphinot L, Pasteau F, Wehrle R, Larrat B, Vitalis T, **Moldrich RX**, Rossier J, Sinkus R, Herault Y, Dusart I, Potier MC (2009) Gene expression signature of cerebellar hypoplasia in a mouse model of Down syndrome during postnatal development. *BMC Genomics* 10: 1-15.

Publications

Lin J, **Harding A**, Giurisato E, Shaw AS (2009) KSR1 modulates the sensitivity of mitogen-activated protein kinase pathway activation in T cells without altering fundamental system outputs. *Molecular and Cellular Biology* 29: 2082-2091.

Lindstrom SH, **Nacsa N**, Blankenship T, Fitzgerald PG, Weller C, **Vaney DI,** Wilson M (2009) Distribution and structure of efferent synapses in the chicken retina. *Visual Neuroscience* 26: 215-226.

Malintan NT, Nguyen TH, Han L, **Latham CF, Osborne SL, Wen PJ, Lim SJT**, Sugita S, Collins BM, **Meunier FA** (2009) Abrogating Munc18-1 SNARE complex interaction has limited impact on exocytosis in PC12 cells. *Journal of Biological Chemistry* 284: 21637-21646.

Martens MA, Wilson SJ, Dudgeon P, **Reutens DC** (2009) Approachability and the amygdala: insights from Williams syndrome. *Neuropsychologia* 47: 2446-2453.

Mattingley JB (2009) Attention, automaticity, and awareness in synesthesia. *Annals of the New York Academy of Sciences* 1156: 141-167.

McGrath JJ, Richards LJ (2009) Why schizophrenia epidemiology needs neurobiology – and vice versa. *Schizophrenia Bulletin* 35: 577-581.

McGrath JJ, Susser ES (2009) New directions in the epidemiology of schizophrenia. *Medical Journal of Australia* 190: S7-S9.

Meunier FA, Mattei CF, Molgo J (2009) Marine toxins potently affecting neurotransmitter release. In *Marine Toxins as Research Tools* ed. Werner E, Müller G. Springer-Verlag Berlin Heidelberg 159-186.

Milford MJ, Wyeth GF (2009) Persistent navigation and mapping using a biologically inspired SLAM system. *International Journal of Robotics Research*.

Millard EL, Nevin ST, Loughnan ML, Nicke A, Clark RJ, Alewood PF, Lewis RJ, **Adams DJ**, Craik DJ, Daly NL (2009) Inhibition of neuronal nicotinic acetylcholine receptor subtypes by **α**-conotoxin GID and analogues. *Journal of Biological Chemistry* 284: 4944-4951.

Moldrich RX, Dauphinot L, Laffaire J, Vitalis T, Herault Y, Beart PM, Rossier J, Vivien D, Gehrig C, Antonarakis SE, Lyle R, Potier MC (2009) Proliferation deficits and gene expression dysregulation in Down's syndrome (Ts1Cje) neural progenitor cells cultured from neurospheres. *Journal of Neuroscience Research* 87: 3143–3152.

Molenberghs P, Cunnington R, Mattingley JB (2009) Is the mirror neuron system involved in imitation? A short review and meta-analysis. *Neuroscience and Biobehavioral Reviews* 33: 975-980.

Mooney JE, Rolfe BE, **Osborne GW**, Sester DP, van Rooijen N, Campbell GR, Hume DA, Campbell JH (2009) Cellular plasticity of inflammatory myeloid cells in the peritoneal foreign body response. *American Journal of Pathology* doi:10.2353/ajpath.2010.090545.

Morrison BJ, Andera L, **Reynolds BA**, Ralph SJ, Neuzil J (2009) Future use of mitocans against tumour-initiating cells? *Molecular Nutrition and Food Research* 53: 147-153.

Mortimer D, Dayan P, Burrage K, **Goodhill GJ** (2009) Optimizing chemotaxis by measuring unbound-bound transitions. *Physica D* 239: 477-484.

Mortimer D, Feldner J, Vaughan T, Vetter I, Pujic Z, **Rosoff WJ**, Burrage K, Dayan P, **Richards LJ, Goodhill GJ** (2009) A Bayesian model predicts the response of axons to molecular gradients. *Proceedings of the National Academy of Sciences of the United States of America* 106: 10296-10301.

Nestor L, **Hester R**, Garavan H (2009) Increased ventral striatal BOLD activity during non-drug reward anticipation in cannabis users. *Neuroimage* 49: 1133-1143.

Nguyen-Huu TD, Mattei C, Wen PJ, Bourdelais AJ, Lewis RJ, Benoit E, Baden DG, Molgo J, **Meunier FA** (2009) Ciguatoxin-induced catecholamine secretion in bovine chromaffin cells: mechanism of action and reversible inhibition of brevenal. *Toxicon* 56: 792-796.

Nourani-Vatani N, Roberts J, **Srinivasan MV** (2009) Practical visual odometry for car-like vehicles. Proceedings - IEEE International Conference on Robotics and Automation, Kobe, Japan 3551-3557.

O'Connell RG, **Bellgrove MA**, Dockree PM, Lau A, **Hester R**, Garavan H, Fitzgerald M, Foxe JJ, Robertson IH (2009) The neural correlates of deficient error awareness in attention-deficit hyperactivity disorder (ADHD). *Neuropsychologia* 47: 1149-1159.

O'Connell RG, Dockree PM, Robertson IH, **Bellgrove MA**, Foxe JJ, Kelly SP (2009) Uncovering the neural signature of lapsing attention: electrophysiological signals predict errors up to 20 s before they occur. *Journal of Neuroscience* 29: 8604-8611.

Oh MM, McKay BM, **Power JM**, Disterhoft JF (2009) Learning-related postburst afterhyperpolarization reduction in CA1 pyramidal neurons is mediated by protein kinase A. *Proceedings of the National Academy of Sciences of the United States of America* 106: 1620-1625.

Parinejad N, **Keshavarzi S**, Movahedin M, Raza M (2009) Behavioral and histological assessment of the effect of intermittent feeding in the pilocarpine model of temporal lobe epilepsy. *Epilepsy Research* 86: 54-65.

Paulk AC, Dacks AM, Gronenberg W (2009) Color processing in the medulla of the bumblebee (Apidae*: Bombus impatiens*). *Journal of Comparative Neurology* 513: 441-456.

Paulk AC, Dacks AM, Phillips-Portillo J, Fellous JM, Gronenberg W (2009) Visual processing in the central bee brain. *Journal of Neuroscience* 29: 9987-9999.

Phan TG, Chen J, Donnan G, Srikanth V, Wood A, **Reutens DC** (2009) Development of a new tool to correlate stroke outcome with infarct topography: a proof-of-concept study. *Neuroimage* 49: 127-133.

Phan TG, Fong AC, Donnan GA, Srikanth V, **Reutens DC** (2009) Digital probabilistic atlas of the border region between the middle and posterior cerebral arteries. *Cerebrovascular Diseases* 27:529-536.

Piper M, Moldrich RX, Lindwall C, **Little E, Barry G, Mason S, Sunn N**, Kurniawan ND, Gronostajski RM, **Richards LJ** (2009) Multiple non-cell-autonomous defects underlie neocortical callosal dysgenesis in Nfib-deficient mice. *Neural Development* 4: 1-16.

Piper M, Plachez C, **Zalucki O, Fothergill T,** Goudreau G, Erzurumlu R, Gu C, **Richards LJ** (2009) Neuropilin 1-sema signaling regulates crossing of cingulate pioneering axons during development of the corpus callosum. *Cerebral Cortex* 19 Supplement 1: 11-21.

Pless SA, Lynch JW (2009) Distinct conformational changes in activated agonist-bound and agonist-free glycine receptor subunits. *Journal of Neurochemistry* 108: 1585-1594.

Publications

Pless SA, Lynch JW (2009) Ligand-specific conformational changes in the α1 glycine receptor ligand-binding domain. *Journal of Biological Chemistry* 284: 15847-15856.

Pless SA, Lynch JW (2009) Magnitude of a conformational change in the glycine receptor β1- β2 loop is correlated with agonist efficacy. *Journal of Biological Chemistry* 284: 27370-27376.

Prowse AB, **Wilson J, Osborne GW**, Gray PP, Wolvetang EJ (2009) Multiplexed staining of live human embryonic stem cells for flow cytometric analysis of pluripotency markers. *Stem Cells and Development* 8: 1135-1140.

Pujic Z, Mortimer D, Feldner J, Goodhill GJ (2009) Assays for eukaryotic cell chemotaxis. *Combinatorial Chemistry & High Throughput Screening* 12: 580-588.

Reinhard J, Srinivasan MV (2009) The role of scents in honey bee foraging and recruitment. In *Food Exploitation by Social Insects: Ecological, Behavioral, and Theoretical Approaches* eds. Jarau S, Hrncir M, Boca Raton, United States of America CRC Press 165-182.

Rich AN, **Mattingley JB** (2009) Out of sight, out of mind: The attentional blink can eliminate synaesthetic colours. *Cognition* 114: 320-328.

Rosa MGP, Palmer SM, Gamberini M, Burman KJ, Yu HH, Reser DH, Bourne JA, **Tweedale R,** Galletti C (2009) Connections of the dorsomedial visual area: pathways for early integration of dorsal and ventral streams in extrastriate cortex. *Journal of Neuroscience* 29: 4548-4563.

Rosoff WJ, McAllister RG, **Goodhill GJ,** Urbach JS (2009) Quantitative studies of neuronal chemotaxis in 3D. *Methods in Molecular Biology* 571: 239-254.

Saha S, Barnett AG, Buka SL, **McGrath JJ** (2009) Maternal age and paternal age are associated with distinct childhood behavioural outcomes in a general population birth cohort. *Schizophrenia Research* 115: 130-135.

Saha S, Barnett AG, **Foldi C, Burne THJ, Eyles DW**, Buka SL, **McGrath JJ** (2009) Advanced paternal age is associated with impaired neurocognitive outcomes during infancy and childhood. *PLoS Medicine* 6: 0303-0311.

Scott EK (2009) The Gal4/UAS toolbox in zebrafish: new approaches for defining behavioral circuits. *Journal of Neurochemistry* 110: 441-456.

Scott J, Martin G, Welham J, Bor W, Najman J, O'Callaghan M, Williams G, Aird R, **McGrath JJ** (2009) Psychopathology during childhood and adolescence predicts delusional-like experiences in adults: a 21-year birth cohort study. *The American Journal of Psychiatry* 166: 567-574.

Silk TJ, Vance A, Rinehart N, Bradshaw JL, **Cunnington R** (2009) Structural development of the basal ganglia in attention deficit hyperactivity disorder: A diffusion tensor imaging study *Psychiatry Research: Neuroimaging* 172: 220-225.

Simpson HD, Mortimer D, Goodhill GJ (2009) Theoretical models of neural circuit development. *Current Topics in Developmental Biology 87:* 1-51.

Srinivasan MV (2009) Honey bees as a model for vision, perception, and cognition. *Annual Review of Entomology* 55: 267–284.

Srinivasan MV, Thurrowgood S, Soccol D (2009) Competent vision and navigation systems from flying insects to autonomously navigating robots. *IEEE Robotics and Automation Magazine* 16: 59-71.

Srinivasan MV, Thurrowgood S, Soccol D (2009) From visual guidance in flying Insects to autonomous aerial vehicles. *Flying Insects and Robots* eds. Floreano D, Zufferey JC, Srinivasan MV, Ellington C. Heidelberg & Berlin: Springer 15-27.

Sritharan A, Egan G, Johnston L, Horne M, Bradshaw J, Bohanna I, Asadi H, **Cunnington R**, Churchyard A, Chua P, Farrow M, Georgiou-Karistianis N (2009) A longitudinal diffusion tensor imaging study in symptomatic Huntington's disease. *Journal of Neurology, Neurosurgery & Psychiatry* 81: 257-262.

van Swinderen B (2009) Fly memory: a mushroom body story in parts. *Current Biology* 19: 855-857.

van Swinderen B, McCartney A, Kauffman S, Flores K, Agrawal K, Wagner J, **Paulk A** (2009) Shared visual attention and memory systems in the *Drosophila* brain. *PLoS ONE* 4: e5989.

Vickerstaff RJ, **Cheung A** (2010) Which coordinate system for modelling path integration? *Journal of Theoretical Biology* 263: 242-261.

Wallis G, Backus BT, Langer M, Huebner G, Bülthoff H (2009) Learning illumination – and orientation-invariant representations of objects through temporal association. *Journal of Vision* 9: 1-8

Walterfang M, Malhi GS, Wood AG, **Reutens DC**, Chen J, Barton S, Yucel M, Velakoulis D, Pantelis C (2009) Corpus callosum size and shape in established bipolar affective disorder. *Australian and New Zealand Journal of Psychiatry* 43: 838-845.

Wan CY, Wood AG, **Reutens DC,** Wilson SJ (2009) Early but not late-blindness leads to enhanced auditory perception. *Neuropsychologia* 48: 344-348.

Wan CY, Wood AG, **Reutens DC**, Wilson SJ (2009) Congenital blindness leads to enhanced vibrotactile perception. *Neuropsychologia* 48: 631-635.

Welham J, Scott J, Williams G, Najman J, O'Callaghan M, **McGrath J** (2009) Growth in young adults who screen positive for non-affective psychosis: Birth cohort study. *Australian and New Zealand Journal of Psychiatry* 43: 61-67.

Whyte KA, Hogg RC, Dyavanapalli J, Harper AA, **Adams DJ** (2009) Reactive oxygen species modulate neuronal excitability in rat intrinsic cardiac ganglia. *Autonomic Neuroscience: Basic and Clinical* 150: 45-52.

Wu CC, Fairhall SL, McNair NA, Hamm JP, Kirk IJ, **Cunnington R**, Anderson T, Lim VK (2009) Impaired sensorimotor integration in focal hand dystonia patients in the absence of symptoms. *Journal of Neurology, Neurosurgery and Psychiatry* 8:659-665.

Wyeth G, **Milford M** (2009) Spatial cognition for robots: robot navigation from biological inspiration. *IEEE Robotics and Automation Magazine* 16: 24-32.

International **Partnerships**

Joining Forces

Three years of discussions and numerous meetings have culminated in QBI signing a Letter of Agreement with the Institute of Biophysics (IBP) in Beijing, a member of the internationally recognised Chinese Academy of Sciences (CAS).

QBI and IBP Directors said the initiative would bring together expertise and advanced technologies in cellular and molecular systems, leading to further discoveries in how functions such as learning and memory are regulated.

"Key research questions – such as the development of the brain, how the neural circuitry functions and how dysfunction leads to mental disorder – will figure prominently in the research," QBI Director Professor Perry Bartlett said.

QBI, The University of Queensland, IBP and CAS have agreed to jointly fund the partnership, with each party committing $160,000 and dedicated laboratory space to the initiative. A program leader is currently being recruited.

One project already underway is focusing on memory and learning in the fruit fly model *Drosophila melanogaster.* QBI's Assoc. Professor Bruno van Swinderen is working with colleagues from IBP to tease apart basic neural circuits that control visual learning and attention by recording multiple sites in the fly brain. Fruit flies are considered a valuable genetic model and these investigations are seen as vital for informing future research.

Strategic Match

QBI has further strengthened its ties with internationally renowned neuroscience facilities after the signing of a Memorandum of Agreement with the Tata Institute of Fundamental Research (TIFR) in India.

Similarly to QBI, the TIFR conducts fundamental research into how the brain functions, making the two facilities well matched for a strategic alliance.

The Agreement promotes cooperation in – and the advancement of – neuroscience through collaborative research projects, and shared conferences and seminars. It also provides early to mid-career researchers and students the opportunity to work in a different research facility.

"Researchers are increasingly working with collaborators from across the globe to expedite research that is vitally needed to treat a number of neurological disorders. The Tata Institute's objectives align closely to those of the Queensland Brain Institute and I have no doubt it will be a productive partnership," Professor Bartlett said.

Researchers expect initial collaborations will focus on improved therapeutic treatments for people affected by depression and other mental illnesses. Nearly one third of depressed patients do not respond to current antidepressant treatments and therefore such research is seen as critical.

Image above: Professor Perry Bartlett (centre) was joined by QBI colleagues at a workshop with IBP researchers in Beijing.

Professional **Service**

Perry Bartlett
- Brain Institute, University of Auckland Scientific Advisory Panel Member
- Motor Neurone Disease Research Institute of Australia Research Committee Member
- National Health and Medical Research Council (NHMRC) Career Development Awards Panel Member
- Prime Minister's Science, Engineering and Innovation Council Transforming Learning and the Transmission of Knowledge Expert Working Group Member
- SpinalCure Australia Director and Scientific Board Chairman

Thomas Burne
- Australasian Society for Psychiatric Research Committee Queensland Representative

Charles Claudianos
- International Union for the Study of Social Insects Meeting Chair

Helen Cooper
- Australian Neuroscience Society Scientific Program Advisory Group Member
- Brisbane Chapter of the American Society for Neuroscience President

Elizabeth Coulson
- Australian Brain Bee Challenge (ABBC) Northern Territory Coordinator
- Australian Neuroscience Society National Council Member
- Fredreichs Ataxia Research Association Scientific Advisory Committee Member
- NHMRC Grants Review Panel Member

Ross Cunnington
- NHMRC Grants Review Panel Member

Darryl Eyles
- NHMRC Grants Review Panel Member

Louise Faber
- NHMRC Grants Review Panel Member

John Kelly
- National Collaborative Research Infrastructure Strategy Imaging Facilities Board Chair

Joe Lynch
- Australian Course in Advanced Neuroscience Member
- Australian Physiological Society National Secretary

Jason Mattingley
- Australian Academy of Science National Committee for Brain and Mind Member
- NHMRC Project Grants Review Panel Chair

Judith Reinhard
- Australasian Association for Chemosensory Science Committee Member
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) Collaborative Research Cluster Management Committee Member

Linda Richards
- ABBC National Coordinator
- Faculty of 1000 Member
- National Association of Research Fellows Queensland Representative
- NHMRC Grants Review Panel Member

Pankaj Sah
- Addiction Neuroscience Network Australia Scientific Advisory Board Member
- Australian Course in Advanced Neuroscience Management Committee Member
- Faculty of 1000 Member
- Neurosciences Australia Integrative Neuroscience Facility Scientific Advisory Committee Member

Mandyam Srinivasan
- Australian Research Council (ARC) Network on Intelligent Sensors and Sensor Networks for Information Processing Advisory Board Member
- Department of Education, Science and Training Research Quality Framework Panel Member
- Australian Academy of Science Sectional Committee on Applied Physical and Engineering Sciences Member

David Vaney
- Australian Course in Advanced Neuroscience Management Committee Member
- Australian Neuroscience Society President
- Federation of Asian and Oceanian Neuroscience Societies Council Member
- International Brain Research Organisation Governing Council Member
- National Vision Research Institute Board of Administration

Robyn Wallace
- NHMRC Postgraduate Scholarships Panel Member

Editorial **Boards**

Acta Psychiatrica Scandinavica
John McGrath, Editorial Board

Advances in Artificial Neural Systems
Mandyam Srinivasan, Editorial Board

Australian and New Zealand Journal of Psychiatry
John McGrath, Editorial Board

BMC Physiology
Pankaj Sah, Editorial Board

BMC Psychiatry
John McGrath, Editorial Board

Brain and Cognition
Jason Mattingley, Editorial Board

Channels
Pankaj Sah, Editorial Board

Clinical Schizophrenia and Related Psychoses
John McGrath, Editorial Board

Cognitive Neuroscience
Jason Mattingley, Associate Editor

Cortex
Jason Mattingley, Associate Editor

Developmental Dynamics
Linda Richards, Editorial Board

Developmental Neurobiology
Perry Bartlett, Editorial Board

Developmental Neuroscience
Perry Bartlett, Editorial Board

Frontiers in Cellular Neuroscience
Louise Faber, Review Editor

Frontiers in Neurogenesis
Perry Bartlett, Associate Editor
Linda Richards, Editorial Board

Genes
Bryan Mowry, Editorial Board

Growth Factors
Helen Cooper, Editorial Board

Hippocampus
Pankaj Sah, Editorial Board

International Journal of Developmental Neuroscience
Perry Bartlett, Editorial Board

Journal of Applied Clinical Pediatrics
Robyn Wallace, Editorial Board

Journal of Attention Disorders
Mark Bellgrove, Editorial Board

Journal of Comparative Neurology
David Vaney, Editorial Board

Journal of Comparative Physiology A
Mandyam Srinivasan, Editorial Board

Journal of Neurochemistry
Frederic Meunier, Handling Editor

Journal of Neurophysiology
Pankaj Sah, Editorial Board

Journal of Neuroscience
Pankaj Sah, Associate Editor

Journal of Neuroscience Research
Perry Bartlett, Editorial Board

Network: Computation in Neural Systems
Geoffrey Goodhill, Editor-in-Chief

Neural Circuits and Systems
Geoffrey Goodhill, Editorial Board

Neural Computation
Geoffrey Goodhill, Associate Editor

Neural Development
Perry Bartlett, Editorial Board

Neural Plasticity
Pankaj Sah, Editorial Board

Neurocase
Jason Mattingley, Editorial Board

Neuropsychologia
Jason Mattingley, Editorial Advisory Board

Neuroscience Research
Perry Bartlett, Editorial Board

Neurosignals
Perry Bartlett, Editorial Board

Open Evolution Journal
Charles Claudianos, Editorial Advisory Board

PLoS Biology
Mandyam Srinivasan, Editorial Board

PLoS ONE
Thomas Burne, Academic Editor
Frederic Meunier, Academic Editor
Bruno van Swinderen, Academic Editor

Psychiatric Genetics
Bryan Mowry, Editorial Board

Revista Brasileira de Psiquiatria, Associação Brasileira de Psiquiatris
John McGrath, Editorial Board

Schizophrenia Bulletin
John McGrath, Editorial Board

Schizophrenia Research
John McGrath, Editorial Board

Stem Cell Research
Perry Bartlett, Editorial Board

Stroke Research and Treatment
David Reutens, Editorial Board

Yonsei Medical Journal
Perry Bartlett, Editorial Advisory Board

UQ Appointments

Perry Bartlett
- UQ Advancement Sub-Committee
- UQ Animal Ethics Committee Chair
- UQ Senior Management Committee

Helen Cooper
- UQ Institutional Biosafety Committee

Elizabeth Coulson
- UQ Research Higher Degree Committee

Ross Dixon
- UQ Occupational Health and Safety Council
- UQ Radiation Health and Safety Committee

Ian Duncan
- Corporate Information Sub-Committee
- Phoenix Program Steering Committee
- UQ Information Technology Consultative Group Chair

Geoffrey Goodhill
- UQ Exellence in Research for Australia Steering Committee

John Kelly
- UQ Administrative Services External Audit
- UQ Biological Resources Steering Committee
- UQ Customer Relationship Managment Project Steering Committee
- UQ INSIGHT Steering Committee

Joe Lynch
- UQ Masters of Neuroscience Program Coordinator

Linda Richards
- UQ Biological Resources Animal Users Advisory Committee Chair

Pankaj Sah
- UQ Library Committee
- UQ Research Committee

Clare Seaman
- UQ Occupational Health and Safety Council

Robyn Wallace
- UQ Animal Ethics Committee

Neuroscience **Seminars**

The Queensland Brain Institute conducts a weekly seminar program giving neuroscientists an opportunity to learn more about the latest developments, often before research is published. The series is designed to challenge researchers in their thinking, promote excellence through the exchange of ideas and lead to future collaborations in neuroscience.

Professor Thomas Albright
Salk Institute, USA
Adapting to environmental change: lessons from colour-opponency in the primate visual system

Professor Michael Arbib
University of Southern California, USA
Template construction grammar and the description of visual scenes

Professor George Augustine
Duke University, USA
Synaptic biophotonics: novel optogenetic methods for defining brain circuitry

Assoc. Professor Madeleine Beekman
University of Sydney
What maintains the natural honeybee hybrid zone in South Africa?

Assoc. Professor Mark Bellgrove
Queensland Brain Institute,
The University of Queensland
Attention deficit hyperactivity disorder (ADHD): linking attentional phenotypes to candidate genes

Professor Darwin Berg
University of California, San Diego, USA
Organising nicotinic input and using it to control glutamate synapse formation in brain

Ms DanaKai Bradford
Queensland Brain Institute,
The University of Queensland
Studies in differentiation and migration in the adult mammalian brain with emphasis on the multi-functional receptor Neogenin

Dr Joanne Britto
Florey Research Institutes, University of Melbourne
Travelling neurons — constructing the cerebral cortex

Professor Matt Brown
Diamantina Institute, The University of Queensland
Common disease genetics in the era of genome-wide association studies

Dr Christopher Chambers
Cardiff University, UK
Neural mechanisms of attention: insights from TMS and concurrent TMS-fMRI

Dr Antony Cooper
Garvan Institute of Medical Research, Sydney
Parkinson's disease — identifying the sub-cellular causes

Dr James Crane
Queensland Brain Institute,
The University of Queensland
Aversive stimuli synchronise neuronal activity and reset oscillatory phase in the basolateral amygdala

Assoc. Professor Ross Cunnington
Queensland Brain Institute,
The University of Queensland
The perception of action and the mirror neuron system

Dr Louise Faber
Queensland Brain Institute,
The University of Queensland
Mechanisms regulating synaptic excitability in the prefrontal cortex

Professor Anirvan Ghosh
University of California, San Diego, USA
Regulation of synaptic specificity in a developing neural circuit

Assoc. Professor Geoffrey Goodhill
Queensland Brain Institute,
The University of Queensland
Building a brain – wiring the brain

Professor Martyn Goulding
Salk Institute, USA
Going walkabout in the spinal cord: genetic approaches for unravelling the neural networks that control locomotion

Professor Peter Gunning
University of New South Wales
Regulation of neuronal morphogenesis by the actin cytoskeleton

Professor Herbert Herzog
Garvan Institute of Medical Research, Sydney
Central control of energy homeostasis via the neuropeptide Y system

Professor Wieland Huttner
Max Planck Institute of Molecular Cell Biology and Genetics, Germany
Neurogenesis and the cell biology of neural stem and progenitor cells

Ms Vilija Jokubaitis
Florey Research Institutes, University of Melbourne
Identification and characterisation of Dab2 — a novel regulator of microglial activation

Dr Soo-Siang Lim
National Science Foundation, USA
The science of learning centres

Dr Elliot Ludvig
University of Alberta, Canada
Real-time prediction machines: how animals learn to anticipate the future

Professor Justin Marshall
Queensland Brain Institute / School of Biomedical Sciences, The University of Queensland
A new form of vision — but why? Circular polarisation vision

Professor John McGrath
Queensland Brain Institute, The University of Queensland / Queensland Centre for Mental Health Research
Advanced paternal age and neurodevelopmental disorders — linking epidemiology with neurobiology

Professor Mayank Mehta
Brown University, USA
Synaptic plasticity, place cell plasticity, oscillations and sleep

Neuroscience **Seminars**

Assoc. Professor Dan Minor
University of California, San Francisco, USA
Structural insights into ion channel function and regulation

Mr Duncan Mortimer
Queensland Brain Institute,
The University of Queensland
Designing the optimal growth cone

Professor Bryan Mowry
Queensland Brain Institute, The University of Queensland / Queensland Centre for Mental Health Research
Towards identifying genetic variants predisposing to schizophrenia

Dr Volker Neugebauer
The University of Texas, USA
Amygdalo-cortical plasticity in pain

Professor Anders Nykjaer
University of Aarhus, Denmark
Sortilin — Live or let die?

Professor Ben Oldroyd
University of Sydney
Searching for a gene for altruism. Genomic studies of anarchistic honeybees

Professor Dennis O'Leary
Salk Institute, USA
Building a brain – building the cerebral cortex

Dr Angelique Paulk
Queensland Brain Institute,
The University of Queensland
Visual processing in the insect brain

Dr Michael Piper
Queensland Brain Institute,
The University of Queensland
Nfia regulates cortical glial development via antagonism of the notch effector Hes1

Dr John Power
Queensland Brain Institute,
The University of Queensland
Neuronal calcium waves: what do they do?

Professor Giacomo Rizzolatti
Universita' Degli Studi Di Parma, Italy
The mirror mechanism: a neural mechanism to understand others

Professor Phillip Robinson
Children's Medical Research Institute,
University of Sydney
Dynamin and synaptic vesicle endocytosis in nerve terminals

Professor John Rubenstein
University of California, San Francisco, USA
Forebrain patterning

Assistant Professor Kang Shen
Stanford University, USA
Molecular mechanisms of synapse formation and axonal transport

Dr Elliott Sherr
University of California, San Francisco's Children's Hospital, USA
Building a brain – developmental and genetic causes of epilepsy and agenesis of the corpus callosum

Professor Michael Shipley
University of Maryland, USA
Building a brain – deciphering functional circuits in the brain

Mr Benjamin Sivyer
Queensland Brain Institute,
The University of Queensland
A retinal ganglion cell that breaks all the rules

Dr Klaus Stiefel
Okinawa Institute of Science and Technology, Japan
Single neuron computation

Professor Seong-Seng Tan
Florey Research Institutes, University of Melbourne
Building a brain — harm minimisation following injury

Ms Divya Unni
Queensland Brain Institute,
The University of Queensland
Slits regulate glial development and corpus callosum formation

Professor Claes Wahlestedt
The Scripps Research Institute, USA
Regulatory RNAs in CNS disorders

Dr Tara Walker
Queensland Brain Institute,
The University of Queensland
Activation of a latent hippocampal stem cell: identifying factors that regulate adult hippocampal neurogenesis

Dr Guy Wallis
Queensland Brain Institute / School of Human Movement Studies, The University of Queensland
In search of a cortical blueprint for object analysis

Dr Christine Wells
Griffith University
Networking through the nose

Professor Harvey Whiteford
Faculty of Health Sciences,
The University of Queensland
The global burden of neuropsychiatric disorders

Dr Stephen Williams
University of Cambridge, UK
Electrically distributed neurons

Dr Kaylene Young
University College London, UK
The life of an oligo progenitor — from birth to old age

Dr Jochen Zeil
The Australian National University, Canberra
View-based homing

QBI **Staff**

Director,
Queensland Brain Institute
Professor Perry Bartlett

Deputy Director *(Research)*
Professor Pankaj Sah

Deputy Director *(Operations)*
John Kelly

Director,
Centre for Advanced Imaging
Professor David Reutens

Faculty
Professor David Adams (finished May)
Assoc. Professor Mark Bellgrove
Dr Timothy Bredy (began August)
Dr Thomas Burne (Adjunct Appointment)
Dr Charles Claudianos
Assoc. Professor Helen Cooper
Dr Elizabeth Coulson
Assoc. Professor Ross Cunnington
Dr Darryl Eyles (Adjunct Appointment)
Dr Louise Faber
*Assoc. Professor Geoffrey Goodhill**
Dr Massimo Hilliard
Professor Joe Lynch
Professor Jason Mattingley
Professor John McGrath (Adjunct Appointment)
Assoc. Professor Frederic Meunier
Professor Bryan Mowry (began August, Adjunct Appointment)
Geoffrey Osborne
Dr Judith Reinhard
*Assoc. Professor Linda Richards**
Professor Mandyam Srinivasan
Assoc. Professor Bruno van Swinderen
Professor David Vaney
Dr Robyn Wallace

** Promoted to Professor, effective 01 January 2010*

University of Queensland Affiliates
Professor Andrew Boyd
Professor Chen Chen
Professor Shaun Collin
Professor Wayne Hall (began November)
Professor Ottmar Lipp (began November)
Professor Justin Marshall
Dr Peter Noakes
Dr Ethan Scott
Professor Peter Silburn (began June)
Professor Walter Thomas
Dr Guy Wallis
Professor Janet Wiles

Adjunct Appointments
Dr Geoffrey Ericksson
Dr Robert Hester
Dr Lawrence Nandam
Professor Brent Reynolds

Honorary Professors
Professor Mary Galea (began December)
Professor Dexter Irvine
Professor Tianzi Jiang (began December)
Professor Hideyuki Okana
Professor Seong-Seng Tan (began July)
Professor Charles Watson (began December)

Industry Fellows
Professor David Gearing

Postdoctoral Fellows
Dr Natalie Alexopoulos (began July)
Dr Daniel Angus
Dr David Ball
Dr Guy Barry
Dr Oliver Baumann
Dr Daniel Blackmore
Dr Arne Brombas
Dr Stanley Chan (began August)
Dr Meiyun Chang-Smith (began February)
Dr Allen Cheung
Dr Robert Colvin
Dr James Crane
Dr Alexandre Cristino (began July)
Dr Xiaoying Cui
Dr Angela Dean (began July)
Dr Andrew Delaney
Dr Ranmalee Eramudugolla
Dr Traute Flatscher-Bader (began April)
Dr Isabel Formella (began April)
Dr Adam Hamlin
Dr Angus Harding
Dr Jill Harris
Dr Julia Hocking (began October)
Dr Matthew Ireland
Dr Dhanisha Jhaveri
Dr Marc Kamke
Dr Refik Kanjhan
Dr Marianne Keller
Dr Nikolai Liebsch (began August)
Dr Tien Luu
Dr Marie Mangelsdorf
Dr Natasha Matthews (began August)
Dr Randal Moldrich
Dr Pascal Molenberghs
Dr Duncan Mortimer
Dr Leonid Motin
Dr Cathrin Müller (began April)
Dr Brent Neumann
Dr Simon Nevin
Dr Tam Nguyen
Dr Shona Osborne
Dr Angelique Paulk
Dr Michael Piper
Dr John Power
Dr Zlatko Pujic
Dr Qiang Shan
Dr Jay Spampanato
Dr Mark Spanevello
Dr Peter Stratton
Dr Robert Sullivan
Dr Alex Sykes
Dr Narelle Tunstall (finished February)
Dr Lata Vadlamudi
Dr Nicholas Valmas (began March)
Dr Bart van Alphen (began August)
Dr Taracad Venkatachalam
Dr Jana Vukovic (began June)
Dr Tim Webb
Dr Francois Windels
Dr Zhe Yang

Research Assistants
Suzanne Alexander
John Baisden
Jessica Barnes
Debra Black
Daniel Bland
Natalie Bland (began September)
Felicity Brown
Tim Butler
Daniel Clarke
Sean Coakley
Dr Carlos Magalhaes Coelho (began November)
Tarrant Cummins (began February)
Oliver Evans
Cheryl Filippich (began December)
Dr Kathryn French
Rachel Gormal (began February)
Justine Haddrill
Melanie Havler
Katelin Haynes
Sophie Hill
Oscar Jacoby
Georg Kerbler (began June)
Leonie Kirszenblat
Pauline Ko
Beatrice Large
Casey Linton
Erica Little
Dr David Lloyd
Eirinn Mackay
Eliza Middleton
Estella Newcombe
Nickless Palstra

QBI **Staff**

Ajay Panwar
Divya Pattabiraman
Matthew Pelekanos (began April)
Thomas Pollak (began March)
Glen Russell (fnished June)
Janelle Scown
Petra Sedlak
Henry Simila
Ashley Skilleter
Heather Smith (began December)
Dean Soccol
Sophie Tajouri
Andrew Thompson
Saul Thurrowgood
Karly Turner
Jack Valmadre (began April)
Joseph Wagner (began September)
Dianne Walker
Dr Wei Wei (began November)
Amanda White
John Wilson (began April)
Oressia Zalucki

Students
Jessica Barnes (began March)
Partha Bhagavatula
DanaKai Bradford
Adrian Carter (finished August)
Kathleen Cato
Charlotte Clark
Lavinia Codd
Stacey Cole
Hayley Cox (began August)
Peter Curby (began January)
Melissa de Vries
Christine Dixon (began January)
Amber-Lee Donahoo
Jiaxin Du (began December)
Michael Dwyer
Claire Foldi
Clare Giacomantonio
Ilan Gobius
Helen Gooch (began February)
Nivetha Gunasekaran
Lu Han (began March)
Lauren Harms
Jonathan Hunt
Thuan Huynh
Md Robiul Islam
Sepideh Keshavarzi
Inga Laube (began March)
Casey Linton
Sha Liu (began March)
Timothy Lynagh
Nancy Malintan
Roger Marek (began June)
Sharon Mason
Linda May
Richard Moore
John Morris (began February)
Duncan Mortimer
Ramesh Krishnan Narayanan (began March)
Kian Bee Ng (began December)
Thai Vinh Nguyen (began July)
Truong Giang Nguyen (began June)
Navid Nourani Vatani
Gemma Olsson (began September)
David Painter (began July)
Thomas Pollak (began July)
Miguel Renteria Rodriguez (began March)
Sumiti Saharan
Hugh Simpson
Benjamin Sivyer
Daniel Stjepanovic
Cornelia Strobel
Gavin Taylor (began May)
Janette Thurley
Divya Unni (finished December)
Qian Wang
Nicola Watts
Jiajia Yuan (began May)
Nikki Zuvela

Institute Manager
Helen Weir
Ray Johnson (maternity leave cover)

Institute Operations Manager
Ian Duncan

Research Management
Senior Research Manager – Rowan Tweedale
Grants and Postgraduate Coordinator – Dr Sylvie Pichelin

Commercialisation
Annita Nugent

Laboratory Support
Scientific Services Manager – Clare Seaman
Judy Bracefield
Jane Ellis
Luke Hammond
Maureen Kearney
Colin Macqueen
Nicholas Nacsa
Virginia Nink
Lida Stjepcevic
Nana Sunn
Mary White
Janette Zlamal

Occupational Health and Safety
Ross Dixon (began April)
Dr Paul Lovelock (finished February)

Information Technology
IT Manager – Jake Carroll
Phillip George (began February)
Toby O'Brien

Special Projects and Events
Alison van Niekerk

Communications
Anna Bednarek (began November)
Ron Hohenhaus
Dee McGrath (began October)

Development and Community Relations
Jenny Valentine

Human Resources
Samantha Leblang (began September)
Jacqueline Perren

Finance and Store
Finance Manager – Katherine Parsonage
Wade Ebeling
Michael Perren
Elizabeth Power (began February)
Nathan Weir
Jason White (finished March)

Technical Services
Technical Services Manager – David Wheeldon
Adam Barry

Personal Assistant to the Director
Deirdre Wilson

Administrative Support
Brenda Campbell
Suzanne Campbell (began October)
Susan Earnshaw
Lesley Green (began July)
Rhonda Lyons
Debra McMurtrie
Charmaine Paiva
Reeza Palamoodu Nazer (began February)
Amelia Sah (began December)
Elizabeth Watts (began June)

In **Appreciation**

Queensland Brain Institute researchers 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 therefore grateful for the support and generosity of its benefactors.

Supporting the Queensland Brain Institute

Donations

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

- *Specific donations for a particular research area*
- *Purchasing scientific equipment*
- *Scholarships for talented students in financial need*
- *Fellowships for early to mid-career scientists*
- *Sponsoring Professorial Chairs*
- *Laboratory dedications*
- *Gifts in memoriam*

Bequests

By leaving a bequest to QBI in your will you are leaving a lasting legacy that accelerates current research as well as preserving future projects. A bequest can include:

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

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

Queensland Brain Institute
Building #79, Upland Road
The University of Queensland
St Lucia QLD 4072

Telephone: +61 7 3346 6300
Facsimile: +61 7 3346 6301
Email: development@qbi.uq.edu.au
Website: www.qbi.uq.edu.au