

# qbi neuroscience news

discovering the fundamental mechanisms that regulate brain function



“If this brain region is damaged ... it can severely disrupt a person’s ability to navigate in new situations. People haven’t made this link before.”

Professor Jason Mattingley

## New Direction in Dementia Research

**How do we maintain our sense of direction in an unfamiliar place? Queensland Brain Institute researchers think they have the answer.**

They have discovered that a particular part of the brain acts like a compass, with different neurons firing depending on the direction people think they are heading.

Lead researcher Dr Oliver Baumann had volunteers learn to navigate to landmarks around a computer-generated maze and then measured their brain activity as they viewed each of the landmarks in isolation.

“Our study provides not only the first evidence of a brain region sensitive to heading direction in people, but also its precise location in the brain,” Dr Baumann said.

Using functional magnetic resonance imaging to monitor people’s brain activity during the testing, neuroscientists found that a small area in the parietal cortex

(located toward the back of the brain) provides critical information about the direction in which a person is heading.

“Here we have evidence in a normal, healthy human population that there is a dedicated cluster of neurons that encodes our sense of direction,” fellow researcher Professor Jason Mattingley said.

“If this brain region is damaged – as in a stroke or Alzheimer’s disease – it can severely disrupt a person’s ability to navigate in new situations. People haven’t made this link before – previously it was just a clinical anecdote.”

He predicted clinicians could eventually use navigational tests, such as those created for this study, as an early dementia probe.

You can view a short example of the navigational maze shown to the volunteers at: [http://s04-2.qbi.uq.edu.au/public/maze/Virtual\\_Maze\\_Baumann\\_and\\_Mattingley.avi](http://s04-2.qbi.uq.edu.au/public/maze/Virtual_Maze_Baumann_and_Mattingley.avi)

### Inside...

**Brisbane to Beijing**  
**PG 2**

Strengthening ties with China

**Shining Light on Schizophrenia**  
**PG 3**

Linking low vitamin D to schizophrenia

**Celebrating Science**  
**PG 4**

How QBI celebrated Science Week

## Director's Message



Welcome to the Spring edition of Neuroscience News.

Neuroscience discovery can be a slow process and it is inevitably an expensive one. As such, QBI researchers foster a number of collaborations and have built enviable partnerships with leading neuroscience research institutes across the globe.

In September I was delighted to officially open a joint neuroscience research facility with the Institute of Biophysics, Chinese Academy of Sciences. This laboratory is the first neuroscience initiative between Australia and China and will focus on answering many of the unknowns in brain research.

2010 has seen the Institute continuing with its grant successes in the recent Australian Research Council (ARC) and National Health and Medical Research Council (NHMRC) grant rounds. In particular, QBI also received its first ARC Linkage Grant that will examine the regulation of neuronal death signalling for the treatment of neurodegenerative diseases.

These grants will allow researchers to further progress their research. In addition to the discoveries that you will read about in these pages, two QBI neuroscientists were recently awarded University of Queensland Foundation Research Excellence Awards. I extend my warmest congratulations to Drs Massimo Hilliard and Michael Piper, who were among 11 researchers recognised by the University this year.

As we look to 2011 as an opportunity to build on the Institute's achievements, I realise that research endeavours are only possible through government funding and the generosity of benefactors – and I am continually grateful for your ongoing support.

*Professor Perry Bartlett FAA  
Director, Queensland Brain Institute*

## Brisbane and Beijing establish a unique Laboratory

**The Queensland Brain Institute has unveiled the first joint neuroscience research laboratory between Australia and China.**

The laboratory, opened in collaboration with the Institute of Biophysics (IBP), Chinese Academy of Sciences (CAS), will be dedicated to studying brain disorders such as depression, schizophrenia and dementia.

Currently 250,000 Australians are affected by dementia; however this figure is expected to rise to 1.3 million Australians and 60 million Chinese by the year 2050.

Professor Perry Bartlett said the new laboratory will build on the two Institutes' complementary skills and more rapidly provide answers to how we can overcome disorders of the brain by improving the function of nerve cells.

"There are currently no fully effective

treatments for neurological brain disorders and we believe new discoveries in this area will revolutionise treatment over the next decade," Professor Bartlett said.

Researchers will initially study learning and memory in fruit flies, which have a simplified brain, before applying this knowledge to humans.

Professor Bartlett explained: "Our project aims to identify the genes regulating learning and memory in fruit flies within three years.

"Understanding how the brain works is the first step in eventually producing appropriate therapeutic drugs for dementia, depression, schizophrenia and other disorders," he said.

CAS Vice President Professor Li Jinghai attended the opening. He said IBP would unveil a complementary laboratory in Beijing in November.

Below: Dr Angeliqe Paulk talks to an IBP delegation at the joint laboratory opening.



# $E_{mx2}(t+1) = E_{mx2}(t) &$

## Doing the Sums on Brain Development

**QBI's computational neuroscientists have done the sums – and found that a mathematical model could help improve the understanding of brain development.**

The model addresses the structure of the cerebral cortex, a region of the brain involved in functions such as vision, touch and motor control.

If the cerebral cortex fails to form correctly in the embryo, a person can develop autism, epilepsy and learning difficulties.

"In the adult, different areas of the cerebral cortex are defined by specific patterns of genes and patterns of connections, which makes the cortical areas highly specialised and quite different from each other," Clare Giacomantonio said.

"We're trying to understand how those specialised areas develop. We're specifically looking at one aspect of that development, which is how the patterns of gene expression form."

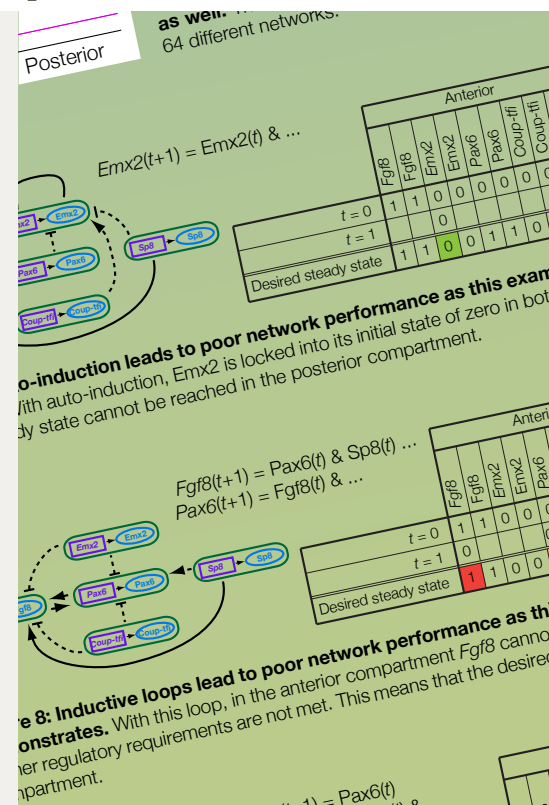
The research, published in *PLoS Computational Biology* in September, is a step forward in understanding normal brain development.

Fellow researcher Professor Geoffrey Goodhill explained "The model helps make it clear which gene interactions are crucial for normal development."

"If we can understand how normal development occurs you can certainly get a better idea of how things can go wrong," added Ms Giacomantonio.

The researchers will now use the model to understand more about the effects of genetic mutations on brain development.

Right: Detail from Clare Giacomantonio's poster 2010 entitled "A computational model of the patterns of gene expression underlying cortical area development."



## Pregnant Women should look on the Bright Side

**Newborn babies with low levels of vitamin D have an increased risk of developing schizophrenia later in life, according to researchers from the Queensland Brain Institute.**

The scientists compared vitamin D concentrations in babies who later developed schizophrenia with healthy controls – and confirmed those with low vitamin D had a two-fold increased risk of developing the disorder.

Vitamin D, or the 'sunshine hormone', is generated when sunshine falls on the skin. While it has long been seen as vital for healthy bones, the team discovered it is also important for healthy brain growth.

Low vitamin D is common in many countries and researchers have previously found that people with schizophrenia are more likely to be born in winter.

Schizophrenia is a poorly understood group of brain disorders that affect about one in 100 Australians, and usually first presents in young adults.

"While we need to replicate these findings, the study opens up the possibility that improving vitamin D levels in pregnant women and newborn babies could reduce the risk of later schizophrenia," investigator Professor John McGrath said.

Findings from the three-year study, published in the *Archives of General Psychiatry*, could eventually inform public health messages, in the same way that pregnant women are encouraged to increase folate to reduce the risk of spina bifida in their children.

Professor McGrath said: "Although the links between vitamin D and bone growth have long been appreciated, the fact that we have discovered it is also important for healthy brain growth is a vital step forward."

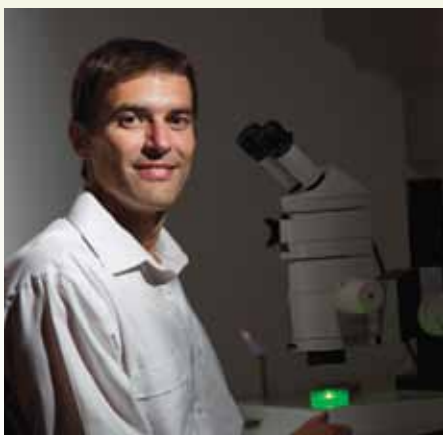
"Vitamin D is necessary for cell growth and communication in all organs in the body, so it's no surprise that a lack of vitamin D has an affect on the developing brain," said fellow researcher Dr Darryl Eyles, who was largely responsible for developing the assay to study the newborns' blood samples.



## Rising Research Stars

**The Queensland Brain Institute has again proven its leadership, with two of 11 University of Queensland Foundation Research Excellence Awards being presented to QBI researchers.**

Dr Massimo Hilliard was recognised for his project aimed at understanding nerve regeneration in the roundworm *Caenorhabditis elegans*, which could eventually enable scientists to rebuild connections in the nervous system after injury.



Animal models with simple nervous systems are vital for this type of research. Each *C. elegans* has only 302 neurons in its entire body, compared with humans who have billions of neurons just in their brains.

“With *C. elegans* we can visualise cells individually, which means we can look at exactly what happens in a single cell after damage. The powerful genetic tools available contribute to make *C. elegans* one of the best systems to find out what is going on molecularly,” Dr Hilliard explained.

Dr Michael Piper was rewarded for his research studying the genes that regulate stem cell differentiation in the embryonic

Left: Dr Massimo Hilliard. Right: Dr Michael Piper.



brain. If the brain fails to form correctly it can lead to a number of different developmental disorders.

“It’s very humbling to get awards like these, as they represent acknowledgement from your peers in the scientific community,” he said.

Professor Perry Bartlett added: “QBI was extremely successful in snapping up these awards – it’s a fantastic achievement.”



## Taking Action for Stroke Patients

**Sometimes you don’t know what you have until it’s gone. That’s often the case for people who lose motor function after their brain is affected by stroke.**

Now a QBI neuroscientist is working to uncover how people can restore voluntary movement.

“Following stroke, brain plasticity plays a critical role in the recovery of normal function. We’re interested in finding out how we can help that process. Specifically if attention – or attending – to motor training can influence how well you recover from injury,” Dr Marc Kamke explained.

He uses transcranial magnetic stimulation, a non-invasive technique, on healthy volunteers to induce and measure plasticity. Early results suggest that attention can modify the brain’s plastic response to procedures in the motor cortex, an area critical for control of movement.

“At this stage we’re testing healthy

younger individuals. The next step is to look at older individuals, as there is some thought that plasticity is reduced in the elderly.

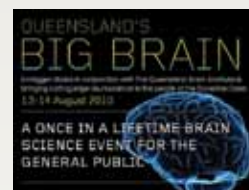
“The ultimate goal is to look at stroke patients, but the first step is to understand what influences plasticity in the normal human brain because there really is a lot to learn,” he said.

The research has been made possible through the generosity of the late Dr Salvatore Vitali, who made a bequest to The University of Queensland for research into the brain.



Above: Dr Marc Kamke.

### CELEBRATING SCIENCE



**Sunshine Coast residents were given the opportunity to hear from a handful of**

**QBI’s leading researchers, when they gathered at a Noosa bookstore in August.**

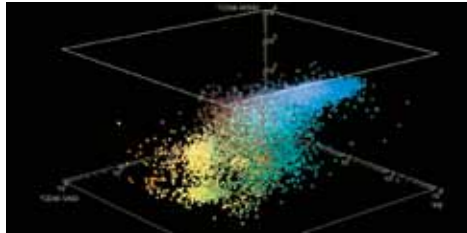
To celebrate Science Week Embiggen Books organised the *Big Brain* mini-symposium which was attended by dozens of local residents wanting to learn more about the field.

Assoc. Professor Helen Cooper opened the event with a presentation on the application of nanotechnology in neuroscience.

She is currently researching the use of nanoparticles as drug delivery systems for the treatment of neurodegenerative disease.

Drs Darryl Eyles, Judith Reinhard, Randal Moldrich and Daniel Blackmore also spoke at the symposium.

## profile Mr Geoffrey Osborne



Above: Characterisation of brain tumour cells.  
Below: Toni Merkens on a 1950s Hetchins racing bike.



**Mr Geoffrey Osborne is unique amongst the Queensland Brain Institute's chief investigators – he is not only a neuroscientist but also a service provider for other researchers.**

The Director of Flow Cytometry, Mr Osborne is responsible for the team that analyses human and animal cells in an effort to learn more about their function and structure and, in turn, their role in disease.

"We take cells that have come from solid tissue or cells in suspension, such as blood, and analyse them on the basis of the way they scatter light and bind fluorescent reporters. Cells from different sources characteristically scatter light in particular ways and this, combined with their fluorescence signatures, gives us insights into the type and function of the cells," he explained.

His team also provides advice to other scientists – both at QBI and externally – who are looking to carry out new experiments, to ensure they are using the best techniques.

One of Mr Osborne's many existing collaborations involves the culturing of blood cells, which could prove lifesaving for people requiring blood transfusions.

"We also work with companies developing hardware and software so that we can influence design, which ultimately leads to better products for QBI's neuroscientists," he said.

"We're never just working on one thing, there's a lot of variety. The great thing is being able to pursue areas that really interest you."

However building from the ground up doesn't stop when Mr Osborne leaves QBI. He is a cycling enthusiast who has restored more than a dozen racing bikes.

"I do all of the rebuilding. It's a constant process – searching the internet for the right parts, keeping in touch with people in Europe – because the goal is to make the bikes as authentic as possible."

His prized set of wheels remain a 1958 Hetchins racing bike that he rebuilt from scratch.

## Grants

Fourth Quarter 2010

SELECTION OF GRANTS RECEIVED

AUSTRALIAN RESEARCH COUNCIL (ARC)

**Professor Perry BARTLETT, Professor Andrew BOYD**

Development of novel reagents that specifically counteract EphA4 to enhance axonal regeneration (ARC Discovery Project, 2011-2013, \$420,000)

**Dr Elizabeth COULSON, Dr Robyn WALLACE, Professor David GEARING**

Regulation of neuronal cell death signalling for the treatment of neurodegenerative diseases (ARC Linkage Grant, 2011-2013, \$430,000)

NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL (NHMRC)

**Professor Pankaj SAH, Dr Francois WINDELS**

Neural correlates of fear conditioning and extinction (NHMRC Project Grant, 2011-2015, \$855,650)

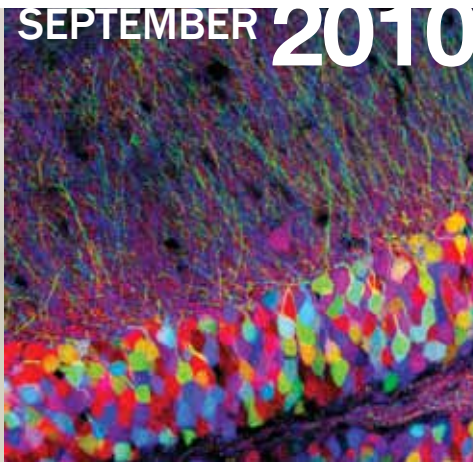
**Dr Ziarh HAWI, Assoc. Professor Mark BELLGROVE, Dr Robyn WALLACE, Assoc. Professor Alasdair VANCE**

Functional characterisation of genetic risk variants for ADHD: From association to biology (NHMRC Project Grant, 2011-2013, \$507,255)

**Despite our on-going grant success, the Institute is still heavily reliant on additional funding. QBI must match every dollar of grant funding with a further dollar to make research possible.**

# qbi events

SEPTEMBER 2010



OCTOBER 2010



NOVEMBER 2010



## Past Events

### BRAIN PLASTICITY SYMPOSIUM

**Mark Twain rarely comes to mind when you think of neuroscience.**

However he was central to a lecture by Professor Ron Davis who tried to debunk the quote "the good Lord didn't create anything without a purpose – but the fly comes close" at the Brain Plasticity Symposium in September.

Professor Davis, from the Baylor College of Medicine, USA, spoke about the importance of the fruit fly *Drosophila* in understanding memory in humans.

"In the past few years we have identified several memory traces. It appears that olfactory learning is actually multiple memory phases in the olfactory nervous system," he said.

A plethora of national and international speakers spoke on topics, covering neural circuit construction and function in sensory systems as well as memory and psychopathology.

Symposium organisers Dr Timothy Bredy and Professor Pankaj Sah said the event was a huge success.

"The poster session was particularly good and provided an opportunity for QBI students and staff to spend time with leaders in the field," Professor Sah said.

### MERSON LECTURE

**The second Merson lecture was delivered by Professor Mu-ming Poo, Director of the Institute of Neuroscience, Shanghai and the Paul Licht Distinguished Professor in Biology at the University of California, Berkeley.**

On 28 October Professor Poo delighted the audience with his talk entitled "Development and maintenance of neuronal polarity", during which he illustrated how scientists are exploring the mysteries of the brain at the cellular and molecular level.

Named after leading Australian businessman and Chairman of the QBI Development Board, Mr David Merson, this well-attended talk is indicative of the growing community interest in neuroscience and the cutting-edge research that is being done in the area of neurological and mental diseases.

The Merson lecture is held on an annual basis. The inaugural lecture - in 2009 - was presented by the renowned international scientist, Professor Giacomo Rizzolatti.

### COMPUTATIONAL NEUROSCIENCE WORKSHOP

**Research leaders from Australia and overseas gathered at the Queensland Brain Institute in early November for the Australian Workshop in Computational Neuroscience.**

First held at QBI in 2006, this two-day workshop gives computational neuroscientists the opportunity to learn more about the latest developments in their field, while also discussing potential collaborations with other researchers.

Computational neuroscience is the study of the information-processing properties of nervous systems, using a combination of mathematical and experimental techniques.

"A computational approach is essential for fully unlocking the mysteries of brain function," said workshop organiser and the head of QBI's computational neuroscience laboratory Professor Geoffrey Goodhill.

Besides leading Australian researchers, this year's guest speakers included Professor Peter Dayan from University College London and Dr Si Wu from the Institute of Neuroscience in Shanghai.

### Coming Up – Vision Down Under 2010 - 01 December

VDU 2010 marks the retirement of QBI's Professor David Vaney from The University of Queensland, which he joined in 1989. It will feature lectures by Professor Vaney's past and present collaborators and colleagues, on topics as diverse as visual neuroscience, axon guidance in arthropods and the Bradshaw rock paintings of the Kimberley. The full program and registration information are available at: [www.qbi.uq.edu.au](http://www.qbi.uq.edu.au)