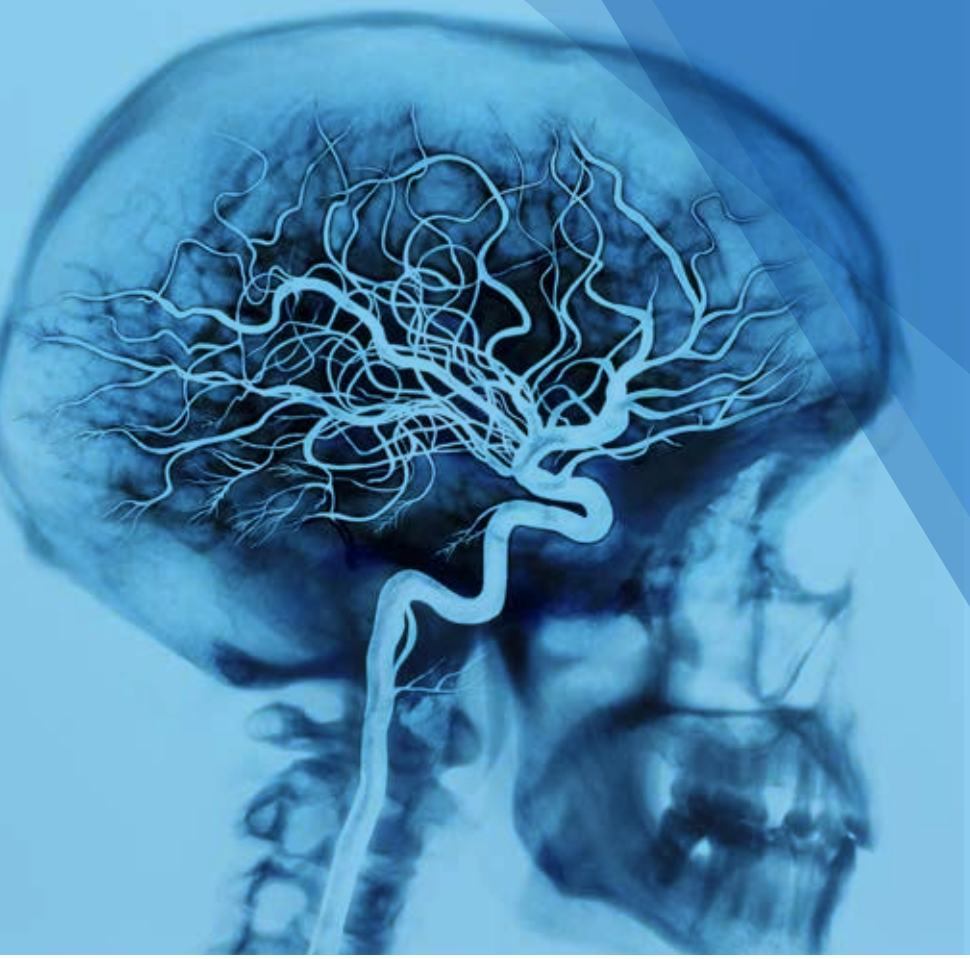
Melbourne Neuroscience Institute



2013
Annual Report

THE UNIVERSITY OF MELBOURNE

MELBOURNE NEUROSCIENCE INSTITUTE

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For further information visit:
www.neuroscience.unimelb.edu.au

Melbourne Neuroscience Institute

2013

Annual Report

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Message from the Director

The Melbourne Neuroscience Institute is built on the energy and drive of its people, and in 2013, that drive was evident in the many successes and achievements of the Institute. On behalf of all researchers, partners and staff of the Melbourne Neuroscience Institute, we present the annual report of 2013.

Research advances depend increasingly on collaboration. Indeed, today's research with the greatest impact transpires from the merging of multiple disciplines. The year, 2013, has been an exciting one, with the Melbourne Neuroscience Institute investing heavily in scientific excellence and the translational potential of our brain disease-oriented research and projects in fields as broad as Medicine, Mental Health, Engineering, Optometry and Vision Sciences, Ophthalmology, Law, Economics, and Social Sciences.

During 2013 we welcomed Associate Professor Andrew Metha to the position of Deputy Director, Melbourne Neuroscience Institute. Andrew has been the Deputy Head of the Department of Optometry and Vision Sciences and leads research programs in live imaging of neurodegeneration, neurovascular coupling and other functional aspects of retinal processing as well as teaching Optometry, Optics and Vision Sciences in undergraduate and graduate degrees. Andrew's role supports our work in establishing strategic research collaborations and development of future funding opportunities with a focus on cross-disciplinary research. Andrew has been working with the Melbourne Neuroscience Institute community across the entire University campus to strengthen and optimise research outcomes and knowledge transfer.

The Melbourne Neuroscience Institute has been successful in attracting a broad base of internal and external stakeholders, with over 400 affiliates. Engagement activities during 2013 included the public seminar series, the annual Melbourne Brain Symposium, the Festival of Ideas 'Brains and Mind for a Healthy Society' Day, workshops on traumatic brain injury and PET/CT applications, the Brain Bee challenge, work experience for secondary school students and hands-on education programs for primary school students. The Melbourne Neuroscience Institute proudly hosted Professor Glenn Schellenberg, Professor of Psychology at the University of Toronto as the 2013 Melbourne Neuroscience Institute International Guest Keynote Lecturer. Glenn tackled the popular idea that music makes you smarter.

The Institute has continued to develop partnerships with industry, academia and key local groups including GlaxoSmithKline, l'Université Pierre et Marie Curie, the Hotchkiss Brain Institute, the World Presidents' Organization, and

the Committee for Melbourne, while taking the lead role in the University's involvement in the management of Australia's largest brain research collaboration, the Melbourne Brain Centre (MBC), a partnership between the Florey Institute of Neuroscience and Mental Health (the Florey), Austin Health, Melbourne Health and the University of Melbourne.

The Institute continues to support and promote four interdisciplinary research themes: the Music, Mind and Wellbeing Initiative, the Centre for Neural Engineering, the Melbourne Brain Centre Imaging Unit and Stem Cells Australia.

We thank our Advisory Board and Committee members whose expert support continues to provide excellent guidance.

All of this could not be accomplished without the dedicated support of the Melbourne Neuroscience Institute core team. I would like to thank Andrew Metha, Trish Weston, Amy Bugeja, Andrew Dalziel and Carmel McFarlane for their ongoing contributions.

Professor Trevor Kilpatrick

Director, Melbourne Neuroscience Institute

Below **Professor Trevor Kilpatrick, Director of the Melbourne Neuroscience Institute.**

Message from the Host Dean

Above **Professor Stephen Smith, Dean of the Faculty of Medicine, Dentistry and Health Sciences.**

The Melbourne Neuroscience Institute has had outstanding successes as the principal coordinator of the University of Melbourne's activities in the neurosciences and related disciplines in 2013. As one of six university-wide institutes dedicated to areas of important societal impact including materials science, social equity, sustainability, energy and broadband, the Melbourne Neuroscience Institute has had considerable impact by fostering key initiatives such as the Centre for Neural Engineering, Stem Cells Australia, the Melbourne Brain Centre Imaging Unit and the Music Mind and Wellbeing Initiative.

Each of these developments highlights that the Melbourne Neuroscience Institute has been able to achieve important collaborations between mainstream neuroscience and related disciplines, whether it be in the physical sciences, social sciences or the arts. Importantly, by promoting several important key interdisciplinary thematic research initiatives, Melbourne Neuroscience Institute has also provided high profile branding for University neuroscience.

Additionally, the Melbourne Neuroscience Institute is responsible for facilitating interactions with affiliated research institutes (Florey Institute of Neuroscience and Mental Health, Melbourne Health, Austin Health) working in the neurosciences through the Melbourne Brain Centre (MBC). The Melbourne Neuroscience Institute is charged with optimising the collaborative function of University staff and students within the MBC, recognising that these researchers are affiliated with eight Departments and three Faculties.

I would like to extend my thanks to Professor Trevor Kilpatrick for his superb strategic vision and leadership as Director of the Melbourne Neuroscience Institute.

Professor Stephen Smith

Dean, Faculty of Medicine, Dentistry and Health Sciences

Research

Music, Mind and Wellbeing

Director:
Professor Sarah Wilson

Music and Education:
Professor Gary McPherson

Music and Audition:
Associate Professor Neil McLachlan

Music and Wellbeing:
Associate Professor Kat McFerran

Music, Mind & Wellbeing (MMW) is a world-first initiative, linking neuroscience with music and social wellbeing through a unique set of collaborations spanning music, science, health, education, and industry. We have three core research strands encompassing music neuroscience, education and health.

Our neuroscience research program incorporates a range of projects relating to the neurobiological basis of hearing, sound recognition, music and speech processing, including how these can change in the context of training or disease. Our work has recently demonstrated that music is a powerful tool for changing the brain across the lifespan. Building on this, our educational research program is investigating the key factors underlying student engagement in music learning and performance in Australian primary and secondary schools. It has led to the development of new pedagogical approaches and instrument ensembles for teaching and learning music in primary schools, and recently demonstrated a highly effective intervention for music performance anxiety in secondary school students. Our health research program investigates the use of music to promote the mental health and wellbeing of individuals and communities, as well as to facilitate recovery following physical or mental illness. Among other things, our recent work has improved our understanding of how adolescents use music to regulate their emotions, and we have convincingly shown that music can be used to aid the recovery of speech and language difficulties following acquired brain injury.

Within our neuroscience research program, recent work includes:

1 new accounts of the brain networks associated with speech and singing, with network plasticity demonstrated following training or the treatment of disease,

2 new cognitive and computational models of speech and sound recognition mechanisms and speech de-noising, including new patented algorithms,

3 new brain-based theories of pitch and dissonance perception, and

4 advances in our understanding of pervasive developmental and psychological disorders, including new methods for their detection based on auditory perception and vocal production tasks.

In 2013, a world-first international study investigating the genetic basis of singing ability was also commenced with the support of seed funding from the Melbourne Neuroscience Institute and the University of Melbourne. This study received comprehensive television, print media and radio coverage in a launch jointly run with the Australian Twin Registry.

Within our educational research program, recent work includes:

1 pilot programs of innovative technologies and approaches to maximise engagement in classroom music education in primary schools, and

2 multiple studies investigating music performance anxiety and the efficacy of psychological strategies to optimise music performance in secondary school and conservatoire students.

Our findings have directly contributed to the Victorian Parliamentary inquiry into music education, and we have been approached by the Victorian Curriculum and Assessment Authority (VCAA) to plan a series of music programs for inclusion in the Victorian teaching support materials for the new National Curriculum.

Within our health research program, recent work includes:

1 completion of a research study showing robust changes in the language network associated with the use of music therapy to improve speech rehabilitation following stroke,

2 completion of a study with the Footscray Community Arts Centre investigating the cognitive benefits of music for individuals with intellectual disabilities, and

3 application of our computational models to understanding the neural plasticity associated with adapting to hearing prosthetics. This research with the Centre for Neural Engineering has provided the first model of hearing with cochlear implants that can explain large individual differences that exist in pitch perception and speech in noise performance. A related interdisciplinary study involves the use of music training to enhance the music perception of recipients of cochlear implants. This study has resulted in the development of innovative software and new instrument technologies.

Below **Music, Mind and Wellbeing team.**

Outreach and Engagement

Our community engagement programs aim to promote new public attitudes that foster grass roots participation in music. Moreover, we support the development of new musical pedagogies and instruments that break down barriers to music participation within

the community, and that are accessible to individuals of varying abilities and intellectual capacity at different stages of the lifespan. To affect our mission, in 2013 we ran a series of high-profile, public events that have been booked to capacity, highlighting the success and broad appeal of these events.

Public Lecture Series: 'Music on the Mind'

For the third consecutive year we co-hosted a popular public lecture series, 'Music on the Mind' with the Melbourne Recital Centre. This series features eminent minds and musicians discussing the relationship between music and the brain and related links to social wellbeing, music participation, learning and development, and the role of music in our contemporary communities. This series has greatly enhanced public engagement in music research and its applications through sell-out attendances at the Melbourne Recital Centre, and through interviews and articles in print, radio and online about the lectures and related research.

Festival of Ideas, 2013: 'Healing Through Art and the Power of Music'

In October, MMW contributed to the Festival of Ideas presented by the University of Melbourne. MMW Director (Professor Sarah Wilson) and music therapist, Dr Jeanette Tamplin, presented a lively interactive session on the health benefits of singing that included audience participation in singing and movement. This formed part of the theme 'Brains and Mind: Healing Through Art and the Power of Music'.

Academic Seminar Series: 'Music, Auditory Cognition and Mind'

Each year, MMW and the Australian Music Psychology Society co-host a series of academically focused research presentations and discussions showcasing the latest findings in music research. These seminars are attended by researchers from a broad range of disciplines as well as music performers and educators and are designed to promote interdisciplinary dialogue between researchers. They are also designed to promote the growth of future research in Australia by engaging student researchers in presentations, discussion and topical debates.

Partnerships

We believe it is essential to attract philanthropic support and sufficient Government and Industry engagement for our work to influence education, health policy and public attitudes. Our research program is underscored by highly-effective partnerships and interest from a wide range of research and service providers, including research collaborations with the Florey, the Centre for Neural Engineering, the Bionics Institute, and the Footscray Community Arts Centre. We also disseminate our research and engage the public in collaboration with the Australian Music Centre, The Music Trust, the Centre for Cultural Partnerships (VCA), the Australian Music Therapy Association and The Melbourne Recital Centre, and provide ongoing advice and consultancies for the Victorian State Government (VCAA) and the Federal Government.

Goals for 2014

In 2014, MMW plans to maintain its research and community engagement profile, with public educational events already being arranged for the Melbourne International Jazz Festival. In addition, scientific presentations are being planned for the world-leading conference in Neuroscience and Music, to be held in France in 2014. We also look forward to developing new research initiatives with our partners, and wish to sincerely thank the Melbourne Neuroscience Institute for its ongoing support of our research and community activities.

Director:
Professor Roger Ordidge
Senior Molecular Imaging Technologist:
Mr Rob Williams
Manager of Research Computing and IT Infrastructure:
Dr Neil Killeen

Melbourne Brain Centre Imaging Unit

The Melbourne Brain Centre Imaging Unit (MBCIU) is based in the Melbourne Brain Centre, Parkville, and we place emphasis on being engaged with the scientific community to enable appropriate usage of imaging technologies. In combination, these advanced imaging technologies will lead to advances in the diagnosis and, hopefully, the eventual treatment of a wide range of neurological disorders. This focus necessitates close collaboration between University of Melbourne scientists and engineers and those in associated institutes, public teaching hospitals, and national and international centres of research excellence.

Outreach and Education

In 2013, Professor Roger Ordidge presented at the MRI Symposium at the University of New South Wales, the Victorian Biomedical Imaging Capability Network Meeting at Monash University, the Dean's lecture at University of Melbourne MDHS Faculty and as part of the PhD coursework programme of the Florey.

Below **Rob Williams conducting a tour for Knowledge Week 2013.**

Rob Williams gave lectures to the Biomedical PhD program and to the visiting Chinese Academy of Sciences. Rob was also the speaker for the University of the Third Age and Lions Clubs to promote the interest of older Australians in the Australian Imaging, Biomarker & Lifestyle Flagship Study of Ageing (AIBL) research program. Rob has conducted a weekend master class for the Australian and New Zealand Society of Nuclear Medicine continuing education program. He has also established a web-based recruitment paradigm for the AIBL research program with websites and podcasts recruiting over a 1000 volunteers.

We also organised the first PET/CT Applications Workshop at the Melbourne Brain Centre and hosted regular tours of the facility. Notable tours included one for the Heritage Society on behalf of the University of Melbourne and the VicHealth Industry Network.

Partnerships

Partnerships have been established with Austin Health in Heidelberg, the Florey, the Royal Melbourne Hospital, Siemens Medical Systems, Cyclotek Ltd, and GE Healthcare.

Goals for 2014

The MBCIU research goals for 2014 are:

- The installation of a new 7 Tesla Siemens MRI Research scanner that will facilitate research including Alzheimer's disease, multiple sclerosis, and traumatic brain injury
- Build on and contribute to PET/CT Alzheimer's Disease Neuroimaging Initiative and AIBL studies
- Make use of multiple imaging techniques (magnetic resonance imaging, MRI; and positron emission tomography, PET)
- Further collaborative interactions with other Victorian biomedical imaging sites (the University of Melbourne, Austin Health, the Florey, and the Royal Melbourne Hospital).

Stem Cells Australia

Director:
Professor Martin Pera
Head of Education, Ethics, Law & Community Awareness Unit:
Associate Professor Megan Munsie

Stem Cells Australia (SCA) is the Australian Research Council's Special Research Initiative in Stem Cell Science, bringing together leading researchers from across Australia to explore the potential role of stem cells in a range of currently intractable diseases.

Led by Professor Martin Pera at the University of Melbourne, this unique collaboration links leading experts from across Australia to develop novel approaches to address stem cell regulation and differentiation. In addition to supporting excellence in stem cell research, SCA also leads public debate and discussion about important ethical, legal and societal issues associated with stem cell science, and provides core service to support the stem cell research community.

Research Highlights

Four main areas of stem cell biology were the focus of SCA's research activities in 2013 – control of pluripotency and reprograming, regeneration and repair in the brain, regeneration and repair in the heart and development of blood – with members contributing to over 100 publications in prestigious journals such as *Cell Stem Cell, Developmental Cell, Journal of Cell Biology, Nature Communications, Nature Cell Biology* and *Proceedings of the National Academy of Sciences.*

One discovery that attracted significant media interest was the ability of our researchers to grow a mini-kidney in the laboratory using stem cells. This discovery paves the way for improved treatments for patients with kidney disease and has significant implications for organ bioengineering.

Recognising the need to support junior investigators and further extend SCA research collaborations, SCA also allocated funding for four new research projects during 2013. These new projects will explore topics ranging from the role of stem cells in the brain following injury, to new ways to track stem cell growth in the laboratory and identify factors which influence induced pluripotent stem cell generation.

Outreach and Education

In a significant move to address community expectation, 2013 saw the launch of several new educational resources for Australians wanting to find about more about stem cells. SCA partnered with the National Stem Cell Foundation of Australia to develop *The Australian Stem Cell Handbook*, which covers topics ranging from what makes stem cells so special, to how stem cells are currently used in research and in the clinic. Importantly, the document raised concerns about unproven stem cell treatments that are currently being offered in Australia and overseas and a guide on how to identify such treatments.

The SCA also contributed to the new National Health and Medical Research Council resource for doctors and patients that focuses on stem cell treatments. At the invitation of leading patient advocacy groups, SCA held public workshops and lectures across the country exploring the hype, hope and progress in stem cell science for conditions such as cerebral palsy, diabetes and spinal cord injury.

Over 450 secondary school students and their teachers attended special workshops in Melbourne, Brisbane and Sydney. Students were shown an award-winning documentary, Stem Cell Revolutions, and then had the opportunity to have their questions answered by a panel of local stem cell experts and the co-producer of the film, the University of Edinburgh's Professor Clare Blackburn. Inspired by the film, the students surprised the panel – and many of their teachers – with their thought provoking questions. The events were arranged by SCA and supported by the National Stem Cell Foundation of Australia and EuroStemCell.

Partnerships

Collaboration is core to SCA operations. Our initiative involves researchers from the University of Melbourne, the University of Queensland, the University of New South Wales, the Victor Chang Cardiac Research Institute in Sydney, the Walter and Eliza Hall Institute of Medical Research (WEHI), the Florey, Monash University, and the CSIRO Material Science Division.

In an effort to forge new international collaborations, SCA hosted a two-day workshop at the University of Melbourne to link researchers from Kyoto University's Institute for Integrated Cell-Material Sciences with SCA members. The workshop was supported by the Australian Department of Foreign Affairs and Trade through the Australia-Japan Foundation. Members of the initiative also secured significant international funding, including the *Fondation Leducq Transatlantic Networks of Excellence*, which was awarded to Professors Nadia Rosenthal and Richard Harvey to better understand the role of these cells in heart function and repair.

SCA also partnered with industry to co-host two symposia featuring national and international invited speakers – *Stem Cells and Cancer* and *Therapeutic Potential of Stem Cells: Prospects & Pitfalls*. Both meetings were well attended by members of the Australian academic and industry communities and provided opportunities to showcase developments in the field, as well as discuss some of the ongoing challenges.

Goals for 2014

Looking towards 2014, SCA will be seeking to:

- Further strengthen the collaborative focus within our current research portfolio
- Establish 'Affiliate Investigators' to acknowledge other leading Australian stem cell researchers whose vision and leadership will further strengthen our initiative

Below **Teachers and students participated in stem cell games as part of Stem Cell Revolutions.**

- Expand our national and international collaborative networks across bioengineering, nanotechnology, stem cell biology, advanced molecular analysis and clinical research
- Continue to call for regulatory reform to curb the sale of unproven stem cell treatments in Australia
- Continue to provide bespoke educational opportunities for high school students, teachers and the public.

Director:
Professor Stan Skafidas
Deputy Director:
Professor Steven Petrou

Centre for Neural Engineering

The Centre for Neural Engineering (CfNE) undertakes interdisciplinary research in neuroscience and neural diseases. The CfNE tackles some of the great challenges of the neurosciences and aims to increase our understanding of neuronal and brain function.

The Centre aims to deliver new biotechnologies, create next generation neural prostheses, and build better engineered systems that replicate biological networks and are resilient to faults.

Research Highlights

During 2013 the CfNE published 64 papers in leading journals and conference procedings in the fields of stem cell biology, neural engineering, genetics, medical bionics and disorders such as psychosis, autism spectrum disorder and epilepsy.

Centre researchers were successful in obtaining $3 million in competitive grants that will be used in coming years for further research in understanding disorders such schizophrenia, psychosis, autism spectrum disorder and epilepsy.

Professor Lloyd Hollenberg, leader of the Sensors and Imaging Laboratory, was awarded a prestigious ARC Laureate Fellowship and the Victoria Prize for his work in nanocrystalline imaging of neurons. Dr Mirella Dottori, co-leader of the Stem Cells and Disease Modeling Laboratory, was awarded an ARC Future Fellowship to undertake research in using induced pluripotent stem cells to model neurological disorders.

Below **Centre for Neural Engineering.**

Partnerships

The CfNE has continued to collaborate on numerous projects with leading national and international centres such as the Florey, the Murdoch Childrens Research Institute, the Walter and Eliza Hall Institute (WEHI), University of California, San Diego, University of California, Los Angeles and

Harvard University. The CfNE was part of the successful National Science Foundation centre for Quantum Materials led by Harvard University. This Centre will focus on new materials and sensors that can be used to permit new measurements of single neurons to better understand their function. CfNE researchers were also part of a successful European Union FP7 grant that is focused on applying machine learning techniques for early identification of individuals at risk of suffering from psychosis.

Goals for 2014

2014 promises to be an exciting year. The CfNE research goals for 2014 are:

- We expect to graduate four PhD students in the area of Neural Engineering
- We aim to increase the number of collaborative interdisciplinary projects by seeding new projects aligned with the strategic initiatives of the CfNE.

Neurosciences and Behavioural Sciences Domain

The Faculty of Medicine, Dentistry and Health Sciences has eight research domains that are grouped into areas of specific research strength. One of these is the Neurosciences and Behavioural Sciences Domain, led by Associate Professor Ann Turnley of the Department of Anatomy and Neuroscience. The research interests of researchers in this domain are grouped into 4 broadly inter-related groups that provide researchers with the opportunity to engage more closely with people who share an interest in their particular area of research focus. These four groups are Neurological Disorders, Behavioural Neurosciences/Psychology and Mental Health, Basic Neurosciences and Advanced Technologies. These are further broken down into specific subdomains, with many researchers having overlapping interests in more than one of these subdomains:

- Neurological Disorders
- Clinical Neurology
- Neurodegenerative Disease
- Epilepsy
- Stroke
- Neurotrauma & Neural Regeneration
- Behavioural Neurosciences/Psychology and Mental Health
- Human cognition and behavioural neuroscience
- Social Psychology and Human Development
- Clinical psychology and clinical neuropsychology
- Psychiatry
- Basic Neurosciences
- Developmental Neurobiology

- Neurophysiology and Neuropharmacology
- Autonomic and Sensory Systems
- Molecular & Cellular Neuroscience
- Advanced Technologies
- Stem Cell Sciences
- Neural Engineering
- Neural Imaging

Domain Research Highlights in 2013

A number of important research papers were published by members of the Domain in 2013. Two highlights were:

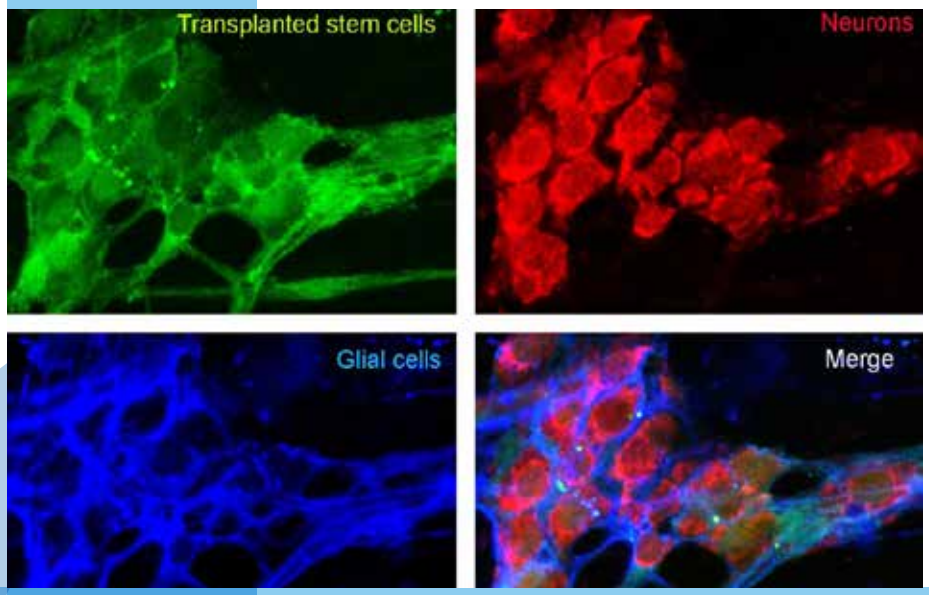
- **'De novo mutations in epileptic encephalopathies'**

  Members of the Epilepsy subdomain headed by Professor Sam Berkovic published a number of papers on genes associated with epilepsy, including a paper in *Nature*, that described a number of new gene mutations associated with epilepsy, as part of a large network called the Epi4K Consortium. This research provided important information on the causes of epilepsy and provides new targets for possible therapeutic approaches.

  A key aspect of the research has been the ability to sequence the entire human genome. Using the latest genetic techniques to sequence and analyse DNA from 4000 epilepsy patients and their relatives, the study shared DNA sequences and patient information among dozens of research institutions. The researchers compared the exomes, or the complete sets of genes, of 264 children with the sequences of their parents who do not have epilepsy. Differences in the sequences of parents and children were analysed to identify potential disease – causing mutations.

  The study's other joint leader Dr David Goldstein, the Director of the Human Genome Variation Centre at Duke University Medical Centre in the

Below **Cells transplanted into the gut become neurons and glial cells.**



US, said his team's work identified an unusually large number of disease-causing mutations and provided a wealth of new information. The research is published in the international scientific journal *Nature, (501, 217–221 (12 September 2013))*.

- **'Transplanted progenitors generate functional enteric neurons in the postnatal colon'**

  Within the wall of the bowel there is an extensive neural network that plays an essential role in regulating gastrointestinal motility. There are several diseases affecting neurons in the gut wall including diabetic gastroparesis (nausea or vomiting caused by food remaining in the stomach for longer than normal), achalasia (difficulty in swallowing) and Hirschsprung disease, a congenital disorder in which neurons are missing from the distal part of the bowel. Current treatments for most diseases of enteric neurons are ineffectual.

  Professor Heather Young's laboratory in the Department of Anatomy and Neuroscience is using mouse models to examine the potential of cell therapy to treat motility disorders caused by diseased enteric neurons. Ryo Hotta (PhD student) and Dr Lincon Stamp isolated neural stem cells from the mouse bowel and then transplanted them into the bowel of recipient mice. They examined the bowel of the recipient mice 4–12 weeks later and found that the stem cells had migrated and generated neurons and glial cells (pictured), and that the neurons were electrically active and received synaptic inputs. This exciting study supports the idea that cell therapy might be used to treat some motility disorders. The work was published in the *Journal of Clinical Investigation (123, 1182–1191, (1 February 2013))* and was also the subject of an article in Science & Vie, the principal French science-based magazine. Ongoing studies are examining whether the neurons derived from transplanted stem cells regulate gut motility. This is important as cell therapy may be a promising strategy for gut nervous system disorders.

Melbourne Neuroscience Institute Research Highlights

Bethlehem Griffiths Research Foundation Medal

This year's prestigious Bethlehem Griffiths Research Foundation Medal has been awarded to Professor Trevor Kilpatrick for his international contribution to multiple sclerosis research and leadership over three decades. Professor

Below **Bethlehem Griffiths Awards evening.**

Kilpatrick's pioneering work has been instrumental in establishing Melbourne as a world centre for Multiple Sclerosis research.

"In the 1970s care of neurological patients was either symptomatic or palliative", Professor Kilpatrick said. "As a young researcher I could see that we were on the cusp of a revolution in imaging and genetics that might just change all that. I wanted to stop this potentially devastating progressive disability affecting young people. The quality of care we can now offer patients has dramatically improved as a result of our research although much remains to be done to remove the spectre and risk of progressive MS."

Professor Kilpatrick has also made inroads into the genes that drive MS and is using this knowledge to develop novel therapeutic approaches. Other work has established the potential importance of Vitamin D deficiency which is now the basis of clinical trial testing to determine whether Vitamin D supplements might have benefits.

Accepting the BGRF Medal, Professor Kilpatrick said it was humbling to receive a medal previously awarded to scientists who are unequivocally the crème de la crème of neuroscience researchers in Australia. He went on to say that it was a privilege to be recognised by an organisation such as the Bethlehem Griffiths Research Foundation with its important focus on helping researchers to assist people with progressive neurological diseases.

Professor Kilpatrick stressed the collaborative nature of his research and acknowledged the enormous contribution of his colleagues and team in Australia and overseas. "It is clear that my achievements are not those of an individual in isolation but of myself as part of a team," explained Professor Kilpatrick.

At the presentation ceremony, the Bethlehem Griffiths Research Foundation also awarded the 2013 Young Researcher of the Year Award to Dr Adam Vogel of the University of Melbourne for his ground-breaking research on overcoming communication and swallowing difficulties in patients with progressive neurological disorders such as motor neuron disease, Parkinson's disease and Huntington's disease.

University of Melbourne enters agreement to develop therapy for Parkinson's disease

The University of Melbourne has entered an agreement with US start-up company Procypra Therapeutics LLC to develop a class of drugs for treating neurological diseases such as Parkinson's disease. Cross-disciplinary research at the University of Melbourne and the Florey has found that a class of synthetic compounds called copper bis (thiosemicarbazones) can potentially treat Parkinson's disease and other neurodegenerative diseases such as motor neuron disease.

Parkinson's disease is a progressively degenerative neurological disorder that affects approximately 6.3 million people worldwide. It causes changes to key proteins in the brain making them toxic. Copper bis(thiosemicarbazone) complex compunds have the potential to treat the disease by preventing these modifications to the proteins.

The research was led by Dr Paul Donnelly (School of Chemistry and Bio21 Institute), Associate Professor Kevin Barnham (Bio21 Institute, the Florey and the Department of Pharmacology) and Associate Professor Anthony White (Department of Pathology). Professor Frances Separovic, Head of the School of Chemistry at the University of Melbourne, welcomed Procypra adopting the University's multidisciplinary approach to develop a treatment for this devastating disease.

Tall Poppies at the University recognised

Dr Adam Vogel (Speech Neuroscience) has been recognised in this year's Young Tall Poppy Science Awards. The awards are run by the Australian Institute of Policy and Science (AIPS) to honour up-and-coming scientists who combine world-class research with a passionate commitment to communicate science.

As part of the Young Tall Poppy campaign, award winners will spend a year sharing their knowledge with school students, teachers and the broader community through workshops, seminars and public lectures. Young Tall Poppies are nominated by their peers and are early career researchers aged 35 or under. Selection is based on research achievement and leadership potential.

Adam studies how communication and swallowing deteriorates in people with progressive brain disorders such as Friedreich ataxia, dementia and Huntington's disease. His research will help improve the understanding of how these problems develop over time and how best to treat them. Dr Vogel said it was a wonderful honour to receive one of the Tall Poppy awards for 2013.

World-first study predicts epilepsy seizures in humans

A small device implanted in the brain has accurately predicted epilepsy seizures in humans in a world-first study led by Professor Mark Cook, Chair of Medicine at the University of Melbourne and Director of Neurology at St Vincent's Hospital.

Professor Cook and his team, with Professors Terry O'Brien and Sam Berkovic, worked with researchers at Seattle-based company NeuroVista, who developed a device which could be implanted between the skull and brain surface to monitor long-term electrical signals in the brain (EEG data). They worked together to develop a second device implanted under the chest, which transmitted electrical information recorded in the brain to a hand-held device, providing a series of lights warning patients of the high (red), moderate (white), or low (blue) likelihood of having a seizure in the hours ahead.

Professor Cook hopes to replicate the findings of the study in larger clinical trials and is optimistic the technology will lead to improved management strategies for epilepsy in the future. Collaborators on the study included the Royal Melbourne Hospital and Austin Health.

"Knowing when a seizure might happen could dramatically improve the quality of life and independence of people with epilepsy", said Professor Cook, whose research was published in the international medical journal, *Lancet Neurology (126, 563–571 (2 May 2013)).*

International Epilepsy Appointment

Professor Patrick Kwan, who has joint appointments at the Royal Melbourne Hospital (RMH) and the University of Melbourne, has been appointed the new Chair of the Medical Therapies Commission of the International League Against Epilepsy (ILAE). The ILAE is the peak international body representing health practitioners and research in the epilepsy field.

Professor Kwan said he was honoured by the appointment and excited to showcase the RMH and the University's expertise in the research and treatment of epilepsy to an international audience.

Professor Patrick McGorry wins prestigious US award

Professor Patrick McGorry AO, Director of the Orygen Youth Health Research Centre, is the recipient of the 2013 National Alliance on Mental Illness (NAMI) Scientific Research Award. It is the first time the award has been presented to a researcher outside of the US.

The award is presented annually by NAMI, the largest grassroots mental health organisation in the USA. It recognises significant contributions to the understanding of mental illness and the advancement of treatment for those who live with these illnesses. The award also recognises efforts in advocacy to increase the wellbeing of people with mental disorders.

The citation stated 'Professor McGorry has played an integral role in the development of safe, effective treatments and innovative research involving the needs of young people with emerging mental disorders, notably psychotic and severe mood disorders. The results of his work have led to the creation and evaluation of holistic and recovery-oriented models of care for young people and their families. Professor McGorry and his key research colleagues have influenced health policy in Australia and other countries, advising governments and health systems.'

Below **Professor Patrick McGorry.**

Robert Sommer Medal for Schizophrenia Research

Professor Christos Pantelis, Professor of Neuropsychiatry, NHMRC Senior Principal Research Fellow and Scientific Director of the Melbourne Neuropsychiatry Centre, has been awarded the prestigious Robert Sommer Medal. Every two years, the Robert Sommer Research Society awards the Robert Sommer Medal to honour outstanding research in the field of schizophrenia. Professor Pantelis' work in schizophrenia and psychosis examines brain changes from childhood to adulthood. Awardees are nominated by the International Jury of the Robert Sommer Research Society and prize winners are also appointed members of the International Jury.

Breakthrough in Multiple Sclerosis Research

Professor Trevor Kilpatrick, Director of the Melbourne Neuroscience Institute, is part of a research team that have made a major breakthrough in unravelling the cause of multiple sclerosis by identifying 48 previously unknown genetic variants that influence the risk of developing the incurable auto-immune disease. The findings from this international research program almost double the number of known genetic risk factors for the disease affecting 23,000 Australians and bring researchers a step closer to developing the first curative treatments. The research was published in the journal *Nature Genetics (45,1353-1360 (29 September 2013))* by the International Multiple Sclerosis Genetics Consortium, of which the University of Melbourne and the Florey are members.

Knowledge Transfer

Public Outreach

Melbourne Neuroscience Institute Public Seminar Program

The Melbourne Neuroscience Institute has had another highly successful year hosting a number of free public seminars on a diverse range of topics. This year's series was run as a set of pilot programs with the aim of broadening our audience and encouraging participation through a more interactive seminar forum. Utilising a panel format rather than a straight lecture has proven considerably more appealing to the public and we have seen a sharp increase in attendance at our public seminar series.

Our 2013 seminars were as follows:

- *Peak Performance* with Dr Don Greene, in conjunction with the Faculty of the Victorian College of the Arts and the Melbourne Conservatorium of Music and Music, Mind and Wellbeing. The presentation addressed the common characteristics of peak experiences, peak performances, and flow states
- *Boosting your Brain Power* in conjunction with the Florey featuring Professor Robert Wood, Professor Nicola Lautenschlager and Dr Jee Hyun Kim, which explored current research into cognitive performance and its decline as we age and the actual medical effects of brain training methods on the brain, our ability to learn and our memory
- *Cannabinoids – The good, the bad and the ugly* featured Professor David Penington, Assistant Commissioner Luke Cornelius, Dr Valentina Lorenzetti, the Melbourne Neuroscience Institute 2013 Fellow and Dr Malcolm Hogg, Anaesthetist and Pain Specialist from the Royal Melbourne Hospital
- *Stem Cell Revolutions – Vision of the Future* was held in conjunction with Stem Cells Australia and included a film screening on the explored the realities behind the hopes and fears associated with stem cell research and a panel session featuring Dr Elizabeth Finkel, Editor of Cosmos.

Melbourne Neuroscience Institute International Guest Keynote Lecture

The Melbourne Neuroscience Institute proudly hosted Professor Glenn Schellenberg, Professor of Psychology at the University of Toronto, as the 2013 Melbourne Neuroscience Institute International Guest Keynote Lecturer. Glenn tackled the popular idea that music makes you smarter. Glenn explored the concept of connections between music and cognitive functioning, a notion that receives considerable attention from scholars and the media. Most people have heard of the Mozart Effect – the notion that you can increase your intelligence by listening to Mozart's music. It's now clear, however, that performance on many tests improves after listening to music because the music elevates the listener's mood and leaves them feeling more alert.

Melbourne Brain Symposium and Student Symposium

The Melbourne Neuroscience Institute and the Florey hosted the annual Melbourne Brain Symposium on Monday 28 October at the Melbourne Brain Centre. This year's program was a testament to the remarkable breadth of neuro-related research happening here and internationally.

We owe a great deal of gratitude to our speakers, and would like to formally acknowledge our speakers and their topics:

- **Synapse complexity**
  Dr Seth Grant, Centre for Clinical Brain Sciences and Centre for Neuroregeneration, Edinburgh University.
- **Developing stem cell therapies for neural repair**
  Associate Professor Clare Parish, the Florey Institute of Neuroscience and Mental Health.
- **Spinal cord injury: time to move physically and philosophically**
  Professor Sarah Dunlop, School of Animal Biology, The University of Western Australia.

Below **Melbourne Brain Symposium 2013 Speakers.**

- **Acute Stroke Therapy: Time is Brain**
  Professor Geoff Donnan, the Florey Institute of Neuroscience and Mental Health.
- **Brain lipid transport in the Alzheimer's disease context**
  Professor Brett Garner, Illawarra Health and Medical Research Institute, University of Wollongong.
- **Gridlock in the Temporal Lobe: Network Hyperexcitability in Alzheimer's Dementia**
  Professor Jeff Noebels, Department of Neurology, Baylor College of Medicine.

Students of Brain Research (SOBR) are a social and academic network designed to facilitate knowledge transfer to students and between students who share an interest in brain research (across Melbourne). The SOBR hosted the Student Symposium on Wednesday 30 October at the Monash Institute of Pharmaceutical Sciences (MIPS). This free symposium provides students with the invaluable opportunity to present their research, hear from prestigious guest speakers and network with other young brain researchers from across Melbourne. Several excellent prizes were awarded to the most outstanding young researchers on the day.

The speakers (Plenary) were Dr Ian Cooke (CRC for Mental Health), and Dr Sarah Meachem (Prince Henry's Institute).

Prize winners were:

Oral:

1st: Sarah Jones, 2nd: Azu Azhan, 3rd: Karinna Fyfe

Posters:

Behavioural Neuroscience & Neurophysiology:

1st: Errol Lloyd, and 2nd: Durgesh Tiwari

Cellular & Molecular Neuroscience:

1st: Parisa Farzanehfar, and 2nd: Myles Minter

Computational, Neuroengineering & Neuroimaging:

1st: David Kaplan, and 2nd: Matias Maturana

Psychology & Psychiatry:

1st: Carolina Restrepo, and 2nd: Megan O'Neill.

Science Communication Award:

Rob Hatch

Victorian Life Sciences Computation Initiative Award:

Shawna Faquharson.

Festival of Ideas

Over six days in October, the University of Melbourne hosted a series of thought-provoking presentations, discussions, debates and special events focussed on 'The Art and Science of Wellbeing.' Commencing with a preview session on September 2, the Festival followed the themes of 'Science in

Society', 'Human Rights, Social Equity and Health', 'Environments', 'Food and Nutrition', 'Families', 'Brains and Mind' and 'Democracy', drawing on the insights of leading thinkers in each of these areas to chart the often circuitous route from powerful ideas to purposeful action.

Professor Trevor Kilpatrick and Professor Fred Mendelsohn were charged with producing the 'Brains and Mind for a Healthy Society' day. Over four sessions our distinguished speakers explored a number of topical issues concerning neuroscience's role in understanding the brain and its behaviour, along with scientific and derivative strategies that could be invoked to further promote both a healthy mind and a healthy society.

Men are from Mars, Women are from Venus

This session focused on gender-related issues. The participants were Dr Cordelia Fine, Professor Jayashri Kulkarni and Professor Kim Cornish.

This thought provoking session raised a number of critical issues for consideration. These included:

- The relationship between the outputs of science and the development of social policy and how these factors may influence community and cultural mores
- The danger of embedding self-fulfilling prophecies in scientific research and how these biases are sometimes captured by the lay press, resulting in the promulgation of 'neurononsense'
- The potential dangers of equating minor quantitative differences in grouped data with predictions about individual differences.

At the core of the debate concerning gender differences is the question about what is predetermined by brain structure versus what is malleable and subject to environmental influence. Addressing this issue, Cordelia Fine suggested that neuroscientists are sometimes caught up studying the concept of predetermined gender differences rather than evaluating how gender experience influences the brain. Nevertheless, Jayashri Kulkarni indicated that sex hormones do influence the stress response, strongly suggesting that there are gender based differences in our susceptibility to mental illness. The corollary to these insights is that the approach to diminish the burden of mental illness, particularly in women, would have to be two-pronged: the first being to reduce the environmental precipitants of mental illness which may be ensconced in gender bias and the second being to explore the pathogenesis of disease by adopting a neurochemical perspective.

After hearing these perspectives the audience poll revealed Cordelia Fine's

proposition had the most support and that we need to resist 'neurosexist' claims that reinforce and legitimise gender stereotypes and roles in ways that are not scientifically justified.

Exploring the Networked Brain

This session focused on the risks and opportunities of social media. The participants were Professor Pip Pattison, Dr Shanton Chang and Associate Professor Alex Fornito.

A number of perspectives were put forward including the premises that 'it's not the medium, it's the context which counts' and 'the more things change the more they stay the same'. Pip Pattison put forward the view that there has been a clear-cut evolution of social dynamics over the past century, catalysed by differences in the communication strategies that we have employed. This has resulted in a transition from a focus on small groups in the early 20th century, to networked groups in the late 20th century, to networked individualism in the 21st century fostered by the internet.

There is an age-dependency in the degree of engagement in social media. This may appear paradoxical as the technology has been designed as intuitive and user-friendly. Perhaps the paradox is explained by the fact that the use of the technology is in the here and now, its weaknesses and strengths being the speed of engagement and the demands for rapid response which fits best with younger users. The participants agreed that independent of these issues, it was important not to look back but to seek opportunities. It was also suggested that Australians to a large extent are 'lurkers' rather than 'leaders' in terms of their use of social media and that strategies to redress this need to be developed if we wish to truly embrace the opportunities that the technology provides.

Out of this session it became apparent that neuroscience has much to offer in developing strategies to help older members of our community cope with change in the digital age. There is also a role for developmental psychology, especially in providing evidence about the consequences of extensive early virtual experience in infants and young children upon acquisition of social skills. It was also suggested that there is value of scholarship in social psychology directed to and focusing on social networks, with attention directed to issues such as network bullying, as well as recognising new opportunities that social networking provides for engagement, for example in democratic processes.

The audience poll revealed Shanton Chang's proposition had the most support, in particular, that we need to understand that social media is not a 'social evil'. Only then can wiser heads help to contribute to and harness the positive potentials of social media for the future.

Growing Brains: Capacity, Intelligence, Resilience

The third session speakers included Mr Ian Stuart, Professor Nick Allen, Associate Professor Lea Waters, Associate Professor Neil Levy and Mr Garang Dut. Clear, common threads emerged from this session, in particular the premise that 'Nurture' matters. It was, however, also acknowledged that it is difficult to dissect causality from correlation in this field of study.

Some of the important points that were made included:

- Nurture is not just about preventing problems but maximising opportunities.
- We are probably underestimating the capacity for abstract thought in the very young.
- It is important to teach self-control, in particular as self-control correlates with the development of executive function and achievement in adult life.
- That parenting is a complex, evolving, multifaceted set of tasks which as a community we probably underestimate and which could benefit from more dedicated attention.

Finally, medical student Garang Dut shared his inspirational life story – detailing his journey from a refugee camp in Kenya to Melbourne. He reminded us that nurturing and sense of community do not always correlate directly with material wealth.

The audience poll revealed Lea Waters' proposition had the most support, specifically that all Australian schools need a wellbeing curriculum that boosts positive mental health in students.

Healing Through Art and the Power of Music

The participants of the final session were Professor Sarah Wilson, Dr Lucy O'Grady, Dr Jeanette Tamplin, Associate Professor Robyn Sloggett and Ms Sade Carrington Buddbarria.

Lucy O'Grady and Jeanette Tamplin provided a dramatic demonstration of the positive psychology of music using audience participation including singing. Sarah Wilson urged us to engage in singing each day to enhance our cognition, mental wellbeing and social cohesion.

Robyn Sloggett and Sade Carrington Buddbarria, an aboriginal artist from the Gija country, talked about promoting the concept of rebuilding through art and cultural conservation and how this could be of mutual benefit for both us here in Melbourne and indigenous communities.

The audience poll revealed that Robyn Sloggett and Sade Carrington Buddbarria's proposition had the majority of support, that being that we must nurture culture to keep people strong and life meaningful.

No-Bell Prize

The day ended back at the Melbourne Brain Centre with the Melbourne Neuroscience Institute hosting the 'No-Bell Prize', a fun and fast-paced session that put five of our brightest academics up against the bell in fierce competition to emphasise the importance of communicating science effectively to the public.

More than ever, people need some understanding of science. A lot of communication we see that is being produced is mostly by scientists for scientists; the information created for the public often has a bias or agenda.

The goal of this session was for our scientists to describe their research in lay terms. Each use of technical jargon attracted a bell ring.

Our panel of judges included Deputy Vice-Chancellor of Engagement for the University of Melbourne, Professor Sue Elliott, and Associate Professor Steve Petrou, an expert in Epilepsy research. The winner with the least bell rings was Dr Bruce Campbell, a postdoctoral researcher from the Melbourne Brain Centre at the Royal Melbourne Hospital. The event was superbly chaired by Science Comedian, Mr Ben McKenzie.

Megan's Mowdown

Multiple Sclerosis Research Australia, Multiple Sclerosis Australia and the Melbourne Neuroscience Institute jointly coordinated the launch of 'Megan's Mowdown'. Megan Healey, a Kulnura mother of three, is one of the 23,000 Australians living with multiple sclerosis (MS). Although Megan is unable to put on her own shoes, she planned an extraordinary adventure, driving a ride-on mower from Melbourne to Sydney to raise funds for MS research.

Embarking from the Melbourne Brain Centre, Parkville on Monday 13 May, the Victorian Parliamentary Health Secretary, Ms Georgie Crozier MLC, attended to lend Victorian Government support and help give Megan an appropriate send-off. Dr Ben Emery from the Department of Anatomy and Neuroscience, University of Melbourne provided a short update on MS research at the Melbourne Brain Centre & MS research developments world-wide.

Below (top) **Megan's send-off from the Melbourne Brain Centre.**
Below (bottom) **Melbourne Knowledge Week Tour.**

Professor Trevor Kilpatrick summed up Megan's extraordinary contribution by stating 'Megan's achievements in raising awareness of MS is crucial for rallying support for ongoing research and funding for treatment for MS'.

Melbourne Knowledge Week

On the 1 November, 15 lucky participants were invited to go behind the scenes at the Melbourne

Brain Centre, Parkville, as part of Knowledge Week 2013. Attendees were given the opportunity to see the laboratories and meet scientists who work on diagnosing and treating brain disorders such as stroke, multiple sclerosis, mental illness and dementia. The tour group visited a multiple sclerosis research laboratory, the Melbourne Brain Centre Imaging Unit and the Dax Centre which houses the Cunningham Dax Collection, consisting of over 15,000 creative works on paper, paintings, ceramics and textiles created by people who have experienced mental illness or psychological trauma.

Melbourne Knowledge Week (MKW) is an initiative of the City of Melbourne and forms an integral part of the Knowledge Melbourne program of activities. The fourth annual MKW was held from Monday 28 October to Sunday 3 November 2013. The program featured over 60 events showcasing Melbourne's diverse and innovative knowledge sectors.

Australasian Society for Stem Cell Research and Questacon Regenerative Medicine Image Competition

The Australasian Society for Stem Cell Research is a Society for stem cell researchers and related professionals in Australia and New Zealand. They run an annual image competition 'Small Objects, Big Impact' to highlight the aesthetics of regenerative medicine research to raise awareness of the patients dealing with chronic disease.

The Melbourne Neuroscience Institute teamed up with Stem Cells Australia to enter a photograph Robert Pask, an advocate for people living with disability and chronic illness. Robert established a unique peer advocacy program for people living with multiple sclerosis, which saw him short-listed for a 2013 National Disability Award. Robert has also been a long-term champion of Australian stem cell research. He has worked with scientists, patients and politicians through the Coalition for the Advancement of Medical Research Australia and other initiatives, to ensure that stem cell research continues to thrive. Importantly, Robert has been able to balance the hype and hope associated with stem cell science, with the true state of progress in the field.

The photograph was taken by part-time artist Amy Bugeja, Project Officer for the Melbourne Neuroscience Institute. The winning photograph was one of 32 that has been framed and put on public display over the next 3 years at the Australian National Science and Technology Centre (Questacon).

Below **The winning photograph of Robert Pask.**

Partnership

Community Leaders Breakfast

On Wednesday 4 September, the Melbourne Neuroscience Institute partnered with the Florey to host a Community

Leaders' Breakfast at the Melbourne Brain Centre. These Breakfasts are held once a month and are hosted on a rotating basis by a different research institute or hospital in the Parkville precinct. They are an opportunity for senior clinicians, researchers and executives to connect with colleagues, peers and associates from across the health, public and business sectors.

Surrounded by panoramic views of Parkville, the breakfast attendees were invited to listen to guest speakers Professor Ingrid Scheffer, Paediatric Neurologist and Professorial Fellow at the Florey and University of Melbourne, and Professor Sam Berkovic, Laureate Professor in the Department of Medicine, University of Melbourne, and Director of the Epilepsy Research Centre at Austin Health on the topic of 'Epilepsy – emerging trends in treatment and research'.

Ausbiotech Networking Event

The Society for Brain Mapping and Therapeutics (SBMT) is a not for profit society organized for the purpose of encouraging interactions between basic and clinical scientists who are interested in areas of brain mapping, engineering, stem cell science, nanotechnology, imaging and medical devices to improve the diagnosis, treatment and rehabilitation of patients afflicted with neurological disorders.

The 11th Annual World Congress of SBMT to be held in March 2014 will bring together physicians, scientists, policy makers, funding agencies and industry to further the advances and applications in brain and spinal cord mapping and image guided therapies (both operative and non-operative).

The Melbourne Neuroscience Institute and Stem Cells Australia hosted a networking event for industry partners on Wednesday 31 July at the Melbourne Brain Centre. This event kick started the campaign for the 2014 World Congress. The night provided the opportunity to network with people from a wide range of disciplines relevant to brain mapping and therapeutics as well as from across the biotech industry.

AMPS Conference

Inaugural Australian Music Research Conference: 'Music, Mind and Health'

Cementing their role as the peak research organisation in music in Australia, Music, Mind and Wellbeing concluded the year with an immensely successful inaugural Australian music research conference, 'Music, Mind and Health' (http://conference.ampsociety.org.au/). This event was held in the Auditorium of the Melbourne Brain Centre, Parkville, co-hosted with the Australian Music Psychology Society. It featured papers and posters from a wide range of disciplines, beginning with a Symposium on Aboriginal & Torres Strait Islander Music and Wellbeing that attracted Indigenous speakers and performers from across the nation. Four Keynote speakers then led sessions that addressed the 4 key themes of the conference, including:

- **Music & Brain:** Keynote presented by Professor Glenn Schellenberg from the University of Toronto.

- **Redefining Music Excellence:** Keynote presented by Professor Bill Thompson from Macquarie University
- **Music & Community:** Keynote presented by Professor Klaus Scherer from the University of Geneva
- **Music & Health:** Keynote presented by Professor Denise Grocke from the University of Melbourne.

Approximately 150 delegates attended the conference from across Australia and around the globe, including researchers from the US, UK, and Europe. Selected papers from the conference will be published in an upcoming Special Issue of the journal, *Psychology of Well-Being* (Springer) and plans for a second meeting are already underway.

Education

Scientists in Schools

In 2013, the Melbourne Neuroscience Institute was pleased to support CSIRO's 'Scientists in Schools' program. Melbourne Neuroscience Institute researchers and academics were offered the opportunity to spend time with teachers and students in Primary Schools from around Victoria. Each partnership is flexible, unique and voluntary – the scientist and teacher decide how they will work together taking account of workloads, the scientist's expertise, and the teacher and class needs. This allows partners to develop their own style and may include hands-on activities, presentations, demonstrations, mentoring, emailing and video conferencing.

Work Experience

Students have the opportunity to gain valuable work experience in a diverse range of neuroscience-related research groups. The Melbourne Neuroscience Institute is committed to providing a secondary schools work experience program designed to:

- Contribute to the development of the skills of young people
- Ease the transition of students into the workplace
- Demonstrate the wide variety of interesting careers available within neuroscience-related research.

The Melbourne Neuroscience Institute work experience program received excellent feedback in 2013, with one teacher commenting "Thanks again for being so supportive and accommodating today. The girls have really been looked after and they can see the work and consideration invested in the packed program you are providing. We are so lucky

Below **Indigenous dancers at the launch of the Australian Music Research Conference: 'Music, Mind and Health'.**

that experts such as yourselves are willing to open your doors to allow the girls to see what science and research can involve".

Imagineering – Primary School visits

The Imagineering project saw over 120 primary school children and their parents visit the Melbourne Brain Centre in 2013. The project is innovative in that it values the role of parents in the support of children's hopes and dreams for the future. Importantly, it involves the children early, before adolescence, to capitalise on the communication between parents and children that occurs around transition to secondary school. The approach provides complementary perspective to Melbourne Neuroscience Institute's activities for years 9–12 students.

Stem Cell Revolutions

Throughout October and November, the Melbourne Neuroscience Institute teamed up with Stem Cells Australia (SCA) to support the Victorian activities of their Australian-wide 'Stem Cell Revolutions' program. SCA and MNI hosted three screenings of the award-winning documentary Stem Cell Revolutions to Australian high school students, their teachers and the general public.

At the student screening, over 130 year 10–12 high school students had the opportunity to have their questions about stem cells and careers in science answered by visiting scientist EuroStemCell's Professor Clare Blackburn, also the co-producer of the film, as well as a panel of local stem cell experts.

Professor Blackburn is based at The University of Edinburgh and her visit to Australia, and the screenings of the film, were generously supported by the National Stem Cell Foundation of Australia as part of their commitment to educating the community about the potential of stem cell science.

Below Dr Victoria Perreau teaching Primary School students.

The film set the scene by telling the history of stem cell research – from how stem cells were first revealed in the body, to the latest scientific and clinical developments. With beautiful drawings to illustrate how stem cells turn into the cells of the body and informative interviews with key scientists – including the 2012 Nobel Prize winners Shinya Yamanaka and John Gurdon, as well as Sir Ian Wilmut, creator of Dolly the sheep – the students were captivated by the possibilities of this exciting field.

One of the Melbourne teachers commented "Students were excited about the possibilities of the research and were able to imagine themselves in the shoes of the people on screen, doing the same great work. They were worried or curious about the implications of the discoveries and were pleased to have the scientists talk to about it".

The evening screening in Melbourne was targeted at teachers, where alongside the screening of the film and a Q&A with scientists we had the chance to interact with the teachers and to show them some of the other stem cell teaching resources developed by EuroStemCell and others.

SCA and the Melbourne Neuroscience Institute would like to thank the Scottish Documentary Institute and EuroStemCell for their support for these events.

The Organisation of the Forebrain

The Melbourne Neuroscience Institute was proud to present a workshop by Professor Charles Watson, entitled 'The Organisation of the Forebrain' in partnership with the Florey on 31 May. The workshop was expertly delivered by Professor Charles Watson DSc, Curtin University, and Neuroscience Research Australia.

Charles Watson is Australia's foremost teacher of brain anatomy. He is an author of over 20 brain anatomy atlases and texts and his rat brain analysis has been cited over 60,000 times. His special skill is translating this knowledge into the teaching of brain anatomy. At a time when most neuroscience is dominated by molecular genetics, knowledge of brain anatomy is becoming a rare attribute and experienced teachers are few.

Brain Bee

On 24 July, 230 year 10 students and accompanying teachers from 37 secondary schools across Victoria participated in the Victorian final of Brain Bee, which was sponsored by the Melbourne Neuroscience Institute and the Florey. The aim of Brain Bee is to motivate and encourage year 10 students to retain their interest in science. The event was officially opened by Hon Peter Hall, Victorian Minister for Higher Education and Skills and Professor Geoff Donnan from the Florey. During the day, the students participated in a quiz about the brain, listened to a talk by Professor Gustav Nossal and received tours of the Anatomy Museum, the DAX gallery and neuroscience laboratories. The prizes included Zeiss microscopes for the winner and runner-up schools (donated by Zeiss) and were presented by Mr David Stewart from Zeiss and Professor Trevor Kilpatrick.

Below **Brain Bee at the Melbourne Brain Centre.**

Partnerships/Linkage Creation

Melbourne Brain Centre and the Florey Institute of Neuroscience and Mental Health

Over 700 scientists work side-by-side in state-of-the-art laboratories next to world-class clinical facilities. This power-house of intellectual capacity and research strength enables the development of more effective diagnostic tools, treatments and ultimately cures for brain and mind disorders.

The Melbourne Neuroscience Institute is unique amongst the six University of Melbourne Research Institutes in that it is charged with facilitating interactions with the Florey and with optimising the communication and interactions between and amongst University staff and students within the Melbourne Brain Centre (MBC), recognising that these researchers are affiliated with eight Departments and three Faculties.

The Melbourne Neuroscience Institute worked with the Florey throughout 2013 on a number of co-branded events that have been included in the 'Knowledge Transfer' section. 2013 saw the Parkville node of the MBC reaching full occupancy.

GlaxoSmithKline Delegation

The Melbourne Neuroscience Institute hosted a delegation from GlaxoSmithKline Research & Development China on February the 19th to explore the concept of a preferred partnership between the two organisations, initially focusing on the neurosciences. Potential collaborative interactions targeting the development of experimental models of demyelination and in vivo assays to measure myelin repair were explored.

Traumatic Brain Injury

The Traumatic Brain Injury Workshop was jointly organised by the Neurotrauma & Neural Regeneration Subdomain of the Faculty of Medicine, Dentistry and Health Sciences and the Melbourne Neuroscience Institute. This event was held on Wednesday 24 July at the Melbourne Brain Centre, Parkville. The workshop was designed to bring together the University of Melbourne

community of researchers, clinicians and allied health workers who specialise in traumatic brain injury and neural regeneration to share updates in their field of expertise, to discuss current clinical priorities in the field, to identify strategies to address these priorities using a knowledge translation approach and to provide awareness of the scope and breadth of basic, clinical and allied health research in this field across the University.

The objectives of the workshop were to identify collaborative projects aimed at bringing neurotrauma research into practice, to formally structure a traumatic brain injury research and clinical network, to investigate the potential for a CRC bid in the field and to scope future funding opportunities. This workshop was attended by several traumatic brain injury researchers and clinicians from Monash University. The program included presentations on basic science and preclinical models, neuroimaging and assessment strategies, clinical research focusing on acute and subacute interventions and finished with presentations on rehabilitation and behaviour.

Brain Injury Cooperative Research Centre

Throughout the world, brain injury is a major cause of suffering, disruption and lost productivity and a significant health cost to every community. Even a brief concussion can lead to the development of cognitive, social or mental health problems. It is estimated that the annual financial and health costs of traumatic brain injury exceed $10 billion in Australia, €65 billion in Europe and $60 billion in the USA.

The understanding of brain injury, optimising treatments and outcomes and improvements in prevention are key research challenges that have been identified by a working group of international leaders in brain injury research from the University of Melbourne, Monash University, the Florey and Neurosciences Victoria. These organisations have complementary areas of research expertise such as longitudinal follow-up studies of head-injury populations, advanced brain imaging capacities, strategies for injury prevention, multicentre clinical trials and policy oriented research to reduce the impact of road trauma and sports related injuries.

The Melbourne Neuroscience Institute is representing the University of Melbourne in development of an application for round 17 of the Cooperative Research Centre (CRC) funding program, to be submitted in June 2014.

The Cooperative Research Centres (CRC) program is an Australian Government Initiative administered by AusIndustry, a division within the Department of Industry. The CRC program supports medium to long-term end user driven research collaborations to address major challenges facing Australia. CRCs pursue solutions to these challenges that are innovative, of high impact and capable of being effectively deployed by the end users.

The proposed Brain Injury CRC will seek $30 million in funding from the CRC scheme for a period of 7 years, to be matched with in-kind contributions from participating organisations. The Brain Injury CRC will have an international

research program directed to patient-relevant outcomes and translation of these outcomes for the benefit of the community. It will focus on brain injury acquired in three major at-risk populations: road users, sportsmen and women and defence personnel.

It is intended that the Brain Injury CRC would be a world leading, outcome-focused initiative that will effectively reduce the societal and economic impact of brain injury for the benefit of affected individuals, practitioners, communities and government.

The Brain Injury CRC will bring together stakeholders with major interest in brain injury, large populations exposed to brain injury and the research expertise and technologies to tackle these challenges in a comprehensive research program aimed at reducing the future risks and burden of brain injury.

7T MRI Scanner – Town Hall Meeting

The 7 Tesla Siemens MRI Research scanner will be installed by June 2014 together with a very sophisticated MR spectrometer (console). A meeting of around 30 prospective users of the system from the University of Melbourne and other organisations was held on 11 December.

Dr Benjamin Schmitt, Scientist and Collaborations Manager AUS & NZ at Siemens Healthcare, presented on the imaging capabilities of the 7T MRI, showing a range of scans comparing 7T to lower field strength MRI.

Professor Roger Ordidge, Chair in Imaging Science, introduced the plan for initial use of the scanner and for benchmarking against standard 3T MRI which will enable the collection of pilot data for research grant applications. Proposals will be invited from local research users, including members of the Victorian Biomedical Imaging Capability (VBIC) and the National Imaging Facility (NIF) with the intent that the scheme will facilitate the collection of data for research grant opportunities.

Below **Sports-related head injuries are a focus for the Brain Injury Cooperative Research Centre.**

PET/CT Applications Workshop

Around 70 industry partners, researchers and students attended a one-day symposium on 11 November designed to educate the Melbourne research community about the research capabilities of the PET/CT facility at the Kenneth Myer building, Melbourne Brain Centre, Parkville and PET/CT

scanning in general. The program included updates by research scientists in their field of expertise and discussion around current clinical priorities and innovative uses of PET/CT.

The workshop covered the principles of PET/CT and its applications to research in neurology, oncology, cardiology as well as the production of radiopharmaceuticals, drug trials and cadaver research.

The objectives of the workshop were:

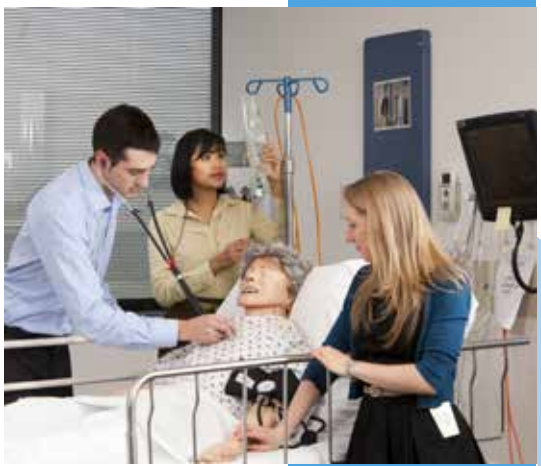
- To identify collaborative projects that use PET/CT to further basic research, translational research and to highlight the potential use of PET/CT in evaluating clinical management options.
- To facilitate methods that can enhance collaboration between pharmaceutical manufacturers and researchers in Melbourne.
- Optimising the use of early radiopharmaceutical markers of PET/CT to identify effective and ineffective therapeutic strategies at an early stage, therefore reducing the cost of pharma research.
- To maximise outcome and minimise costs of research by optimising the batch use of specialised research and radio-pharmaceuticals by sharing resources, and improving the recruitment of subjects.
- To explore potential partnerships within the Parkville precinct and with allied institutions in Melbourne.
- To build links with pharmaceutical, chemical, biological and physical chemistry oriented researchers in order to promote innovation.

University of Toronto

During 2013, Trevor Kilpatrick had a series of meetings with members of the senior executive of the University of Toronto to explore potential interactions in the Neurosciences between the two Universities. Discussions were held with Professor David Naylor (President), Professor Peter Lewis, (Associate Vice-President, Research) and Professor Alison Buchan, (Vice Dean Research & International Relations in the Faculty of Medicine).

Université Pierre et Marie Curie

Trevor Kilpatrick and colleagues attended a French-Australian collaborative workshop in the Neurosciences in June 2013 in Paris, aimed at forging interactions between the Melbourne Neuroscience Institute and the Université Pierre et Marie Curie. The interactions have led to substantive links, including plans for student exchange in 2014.



Funding Initiatives

Research Funding Highlights

NHMRC Success by Melbourne Neuroscience Institute Fellows

2012 Melbourne Neuroscience Institute Fellow, Dr Sandy Schultz, was successful in obtaining a $496,842 NHMRC project grant as CIA of the project 'Investigating the consequences, pathogenesis, and treatment of repeated brain concussions in a novel rodent model'. Our 2013 Melbourne Neuroscience Institute Fellow, Dr Toby Merson was also highly successful in the NHMRC project grant round as CIA of the project 'Investigating mechanisms of axonal pathology following oligodendrocyte apoptosis: avenues for neuroprotection in early MS', being awarded $655,558.

Interdisciplinary Seed Funding Success

The research projects carried out by past Interdisciplinary Seed Funding recipients have led to many successful applications to subsequent competitive grant funding rounds. Some examples:

- **Associate Professor Ann Turnley:** NHMRC project grant (2013–2015) – Enhancement of newborn neuron survival to promote repair following adult brain injury
- **Dr Steven Petrou:** ARC Discovery Project (2012–2014) – Brain sodium channel: functional role of developmentally regulated alternative splicing
- **Associate Professor David Grayden:** NHMRC Project Grant (2013–2015) – Monitoring Cortical Excitability using a Probing Stimulus for Epileptic Seizure Anticipation
- **Professor Lloyd Hollenberg:** ARC Australian Laureate Fellowship (2013–2018) – New Views Of Life: Quantum Imaging In Biology
- **Professor Anthony Burkitt:** ARC Discovery Project (2014–2018) – Neural Activity Shaping for Retinal and Cochlear Implants
- **Associate Professor Richard Hughes:** ARC Linkage Grant (2012–2015) Development of INSL5 peptide analogues as novel therapeutics and Multiple Sclerosis Research Australia (2012–2013) – Examination of BDNF mimetics as promoters of central nervous system myelination.

Research Theme Grant Reports

Stem Cells Australia

The Structure Of Dyrk1 Kinase, An Important Regulator Of Neural Stem Cells Implicated In Down's Syndrome

CI: Professor Martin F. Pera, Stem Cells Australia, University of Melbourne

Team Members: Associate Professor Spencer Williams, Department of Chemistry, Dr Paul Savage, CSIRO Materials Science

Research Project Detail: In a collaboration between Prof Martin Pera (Stem Cells Australia), Assoc Prof Spencer Williams (School of Chemistry and Bio21 Institute, University of Melbourne), and Dr Paul Savage (CSIRO Materials Science and Engineering), we are investigating the mechanism of action of a stem cell modifier, ID-8, which maintains an undifferentiated state in stem cells cultured under so-called 'xeno-free' conditions. A kinase screen at the Reaction Biology Corporation identified a remarkable selectivity for ID-8 against the previously identified candidate target, the protein kinase DYRK1A, which has been implicated in a variety of aspects of cellular differentiation.

Goals for 2014: Efforts are now being directed at understanding the molecular basis for the interaction of ID-8 with DYRK1A to empower future medicinal chemistry studies to improve the potency of this drug. A collaboration has been initiated with a world-acknowledged expert, Prof Stefan Knapp (UK) to determine the three dimensional structure of ID-8/DYRK1A complexes. These efforts have thus far yielded poorly crystalline samples of the protein which are as yet unsuitable for crystallography. In parallel, the effect of ID-8 on cell differentiation is being compared with other known DYRK1A inhibitors to gain supporting evidence that the unique capabilities of DYRK1A reside in activity against this kinase and not other as-yet-unknown targets.

Below Associate Professor Ann Turnley, NHMRC project grant recipient.

Melbourne Brain Centre Imaging Unit

Meso-scopic MRI: Imaging the gap between macro- and microscopic structure

CI: Professor Roger Ordidge, Melbourne Brain Centre Imaging Unit

Team Members: Dr Leigh Johnston, Department of Electrical and Electronic Engineering

Research Project Detail: The principles of meso-scopic MRI were tested on mouse brains. To further explore this area, Professor Ordidge has devised a further significant improvement which requires reversal of the encoding gradient direction in two consecutive scans and using the phase difference between scans to quantify microscopic structure variation at a sub-pixel level.

Goals for 2014: Although the new modifications are trivial on a commercial MRI body scanner, the Bruker Biospec that controls the 4.7T animal scanner requires re-programming to implement this much needed improvement. This work will provide the basis for an NHMRC development grant in 2014.

Centre for Neural Engineering

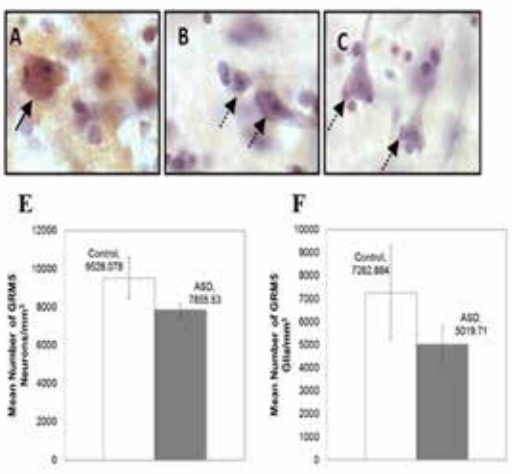
Role of glutamate receptor, metabotropic 5 (GRM5) guanine nucleotide binding protein (G protein), alpha activating activity polypeptide O (GNAO1) and potassium large conductance calcium-activated channel, subfamily M, beta member 4 (KCNMB4) in Autism Spectrum Disorder

CIs: Dr Gursharan Chana, Melbourne School of Engineering and Department of Psychiatry, Professor Stan Skafidas Melbourne School of Engineering

Research Project Detail: Role of glutamate receptor, metabotropic 5 (GRM5) guanine nucleotide binding protein (G protein), alpha activating activity polypeptide O (GNAO1) and potassium large conductance calcium-activated channel, subfamily M, beta member 4 (KCNMB4) in Autism Spectrum Disorder

Using funds from the Melbourne Neuroscience Institute we have followed up on our qualitative reduction in GRM5 in ASD by carrying out stereological analysis of brain samples from patients with ASD and controls. This data is show in Figure 1.

Below **Figure 1.**



The results for this preliminary stereological investigation provide important validation at the protein level that GRM5 expression is decreased in ASD. This is in keeping with reduced mRNA expression demonstrated by us at the gene expression level. This data has provided important preliminary data for an NHMRC project grant submitted for the current funding round that will extend on this data as well as carrying out more mechanistic studies to look at the role of GRM5 in the causation of ASD and the interaction of GNAO1 and KCNMB4.

Goals for 2014: Our goals for this year will be to request further brain tissue from the Autism Tissue Program (ATP) in order to extend and verify the findings above. We will also continue our in vitro mechanistic studies looking at how increasing GRM5 activity may be protective against pathological substrates associated with ASD, in particular activation of microglia.

Music, Mind and Wellbeing

Investigating the genetic basis of singing: a twin study

CI: Professor Sarah Wilson, Melbourne School of Psychological Sciences

Team members: Professor Gary McPherson, Melbourne Conservatorium of Music, Professor Sam Berkovic, Austin Health, Professor Isabelle Peretz, University of Montreal, Yi Ting Tan (PhD candidate)

Research Project Detail: In 2013, a world-first international study investigating the genetic basis of singing ability was commenced with the support of seed funding from the Melbourne Neuroscience Institute and the University of Melbourne. The study employs a twin design to investigate the relative contributions of genes and environmental factors to singing ability, by comparing the pitch accuracy of monozygotic and dizygotic twins. This proof-of-concept study will provide a decisive first step towards establishing a genetic basis for singing ability and a reliable foundation for subsequent neuroscientific research.

To collect pitch accuracy data and other relevant music variables from twins across Australia, a collaborative relationship was first established with the Australian Twin Registry (ATR). In early 2013, sophisticated new online software was then developed and pilot-tested to provide a real time, objective assessment of singing and music ability regardless of the participant's geographical location or computer resources. Subsequent to this, a highly successful media launch was jointly run with the ATR that received comprehensive television, print media and radio coverage, reaching an estimated 1.5 million people. Recruitment of twins officially commenced in May 2013 and so far 775 twin pairs have received email invitations from the ATR to participate in the online study. Of these, so far 106 twins have responded and completed the online study.

Also this year, our research team has also undertaken a comprehensive review of the literature investigating the genetic basis of music ability. This review is currently under consideration for publication in a special Issue of the journal, *Frontiers in Auditory Cognitive Neuroscience*, which is addressing the topic, 'Changing the brain through music: Genes or environment?' Tan YT, McPherson GE, Peretz I, Berkovic SF, Wilson SJ. The genetic basis of music ability. Frontiers in Auditory Cognitive Neuroscience (under review).

Goals for 2014: Another round of large-scale recruitment has been organized with invitations provided to 300 twin pairs to participate in the project in late January 2014. We plan to reach our recruitment target of 120 twin pairs and complete data collection by June 2014, so that data analysis can commence in the latter half of 2014. Empirical publications reporting our initial findings will then be prepared and a media release to report the results subsequently

arranged. We also plan to submit a large-scale ARC grant application based on the findings of our proof-of-concept study to the Australian Research Council in 2015. This funding would expand the research program to molecular studies aimed at identifying the gene loci that influence singing ability.

Psychological Sciences

Decoding preference reversals in economic decision-making from brain activity

CI: Dr Stefan Bode, Melbourne School of Psychological Sciences

Team Members: Dr Carsten Murawski, Department of Finance, Professor Philip L. Smith, Melbourne School of Psychological Sciences

Research Project Detail: Decision-making is a fundamental aspect of human behaviour. Many decisions involve a choice between options that differ not only in reward magnitude (e.g. $20 vs. $30) but also in the delay to receiving the reward (e.g. today vs. 7 days). In such a case, the decision-maker faces a trade-off between reward magnitude and delay. A common task to study this trade-off is temporal discounting, in which participants are asked to choose between a smaller, sooner reward and a larger, later reward of the same value in today's terms. Our functional magnetic resonance imaging (fMRI) study investigated how information about reward and delay are integrated on a neural level in this task, depending on which information is available to the decision-maker first. Participants always had to decide between a standard smaller, sooner reward option ($20 now) and larger, later reward options (e.g. $30 in 7 days) across a range of possible delays and amounts. Importantly, the order of delay (e.g. 7 days) and amount (e.g. $30) was systematically varied such that in half the experiment time information was given first while in the other half amount information was provided first. It was hypothesised that because the delay to wait is a negative feature, while the larger magnitude is a positive feature compared to the immediate choice option, choices as well as the neural integration of these two features should differ depending on the order of presentation. We will apply novel multivariate pattern classification techniques to the fMRI data to directly decode the features of the choice options and their integration into final choice outcomes from brain activity.

Issues/Outcomes: Project preparation, piloting and fMRI data acquisition took place in 2013 at the Monash Biomedical Imaging Centre at Monash University, as specified in the initial grant application. The project is technically highly demanding and heavily relies on novel pattern classification techniques, which have to be adjusted and applied to our data-set. For this, our custom-made toolbox had to be modified and will be ready for application in early 2014. Data pre-processing for all participants is finished, but the main analysis is currently ongoing and will continue for the forthcoming few months.

Goals for 2014: We aim to finalise the fMRI data analysis during the first half of 2014, and

outcomes will be presented during the second half of 2014 at key national and international conferences. At the same time, we will write up the project for publication with the goal to submit the paper in late 2014, aiming for publication in early 2015. The project will be the basis for a grant application to the ARC in 2015.

Interdisciplinary Seed Funding

Four Interdisciplinary Seed Funding applicantions were successful for 2013. Scott Kolbe and Terence O'Brien were awarded funds through Melbourne Research and Fiona Judd and Neil McLachlan were awarded dedicated funding from Melbourne Neuroscience Institute.

Investigating the genetic basis for neurodegeneration in multiple sclerosis using integrative and automated informatics

CI: Dr Scott Kolbe, Centre for Neuroscience Research

Team Members: Dr Neil Killeen, Department of Anatomy and Neuroscience, Mr Wilson Wei Liu, Department of Anatomy and Neuroscience, Professor Trevor Kilpatrick, Department of Anatomy and Neuroscience, Professor Bruce Taylor, Menzies Research Centre and Dr Jac Charlesworth, Menzies Research Centre

Research Project Detail: Recent advances in genetic research methods have led to the identification of a large number of susceptibility genes associated with the complex human disease, multiple sclerosis (MS). While these advances have provided insights into the initiating mechanisms of the disease, the genetic determinants of disease severity in MS remain largely unknown. MS is a clinically heterogeneous disease; however, it is known that the severity of the disease is shared within families. Therefore, it is likely that genetic factors play an important role in determining disease severity.

Identifying the genetic determinants of disease severity is difficult because research has focussed on the degree of inflammation rather than neural injury and repair. However, MRI-based measures can act as surrogates for both the extent of inflammation (e.g. T2 lesion load), neurodegeneration (e.g. cerebral atrophy) and the extent of glial and neuronal injury (e.g. quantitative MRI techniques such as diffusion weighted MRI). By studying the change in these MRI measures over time it is possible to predict long-term clinical outcome.

Therefore, in order to understand the genetic determinants of disease outcome in MS, genetic data must be compared to MRI change over time from a large patient cohort. Such a study requires the integration of large MRI and genomic datasets together with automated analysis methods, which presents interesting analytical challenges. This project aims to develop a series of information technology tools that can perform semi-automated MR image analysis of large datasets from multiple collaborating clinical MRI sites around Australia.

Issues/Outcomes: In 2013 our research group has:

- Developed MR image analysis tools that can be used to measure brain volume and brain lesion volume from clinical MRI scans

- Integrated these analysis tools together with a secure data repository (DaRIS) to allow data to be analysed and results stored back into the repository using a simple web-interface.

This research has overcome several issues with automated data processing including:

- Development of tools that allow for manual quality assurance steps to be applied within the automated processing pipeline so that analysis methods can be easily optimised for data
- Reprocessing the development of tools that allow parallel data processing that takes full advantage of supercomputing facilities at the University, the ability to flexibly store and reprocess data within the secure DaRIS storage and management environment.

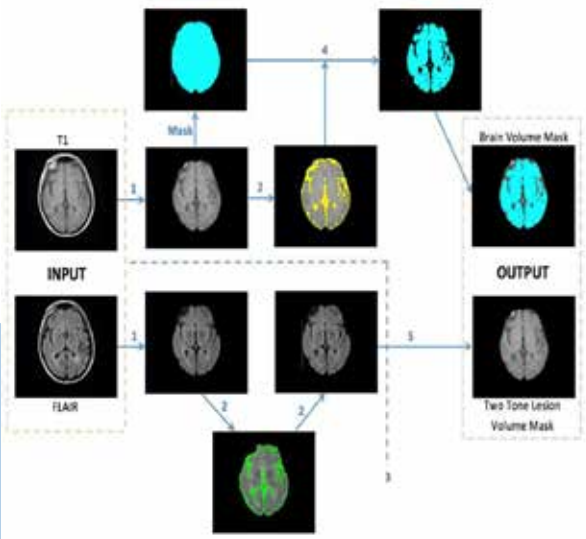
Goals for 2014: The development of the software tools required is largely complete so the aims of the project have been fulfilled. We will now commence using the software to process the >400 multi time-point MS patient datasets that have been transferred and collated within DaRIS. We hope to complete all data processing in 2014.

A pilot study of positron emission tomography to image microglial activation in-vivo in patients having an acute relapse of multiple sclerosis

CIs: Professor Terence J. O'Brien, Department of Medicine (RMH), Coordinating Investigator: Ms Lucy Vivash, Department of Medicine (RMH)

Team Members: Professor Rodney Hicks, Centre for Molecular Imaging, Associate Professor Andrew Katsifis, Royal Prince Alfred Hospital and ANSTO, Professor Roger Ordidge, Department of Anatomy and Neuroscience, Professor Chris Pantelis, Department of Psychiatry, Dr Rob Ware, Cyclotek and Peter Mac, Mr David Krenus, Cyclotek, and Professor Trevor Kilpatrick, Department of Anatomy and Neuroscience

Below **This figure demonstrates the image outputs from the analysis algorithm.**



Research Project Detail: Molecular imaging with positron emission tomography (PET) can provide novel insights into the mechanisms of common and disabling neurodegenerative brain diseases, such as multiple sclerosis, schizophrenia and traumatic brain injury, by allowing the activation of specific cellular processes to be studied in living people. Ultimately this can provide biomarkers to inform the treatment and prognosis of patients being treated for these conditions. The opening of the state-of-the art PET/CT facility in the Melbourne Brain Centre, which is dedicated to research in brain diseases, provides a new opportunity for neurological researchers in Melbourne to utilize this powerful technology. This project is utilising a novel PET brain tracer to

investigate the activation of the inflammatory brain cells, microglia, during and between acute attacks of multiple sclerosis. The implications of this study will extend well beyond multiple sclerosis, as microglial activation is believed to represent a prognostic indicator and therapeutic target for wide range of neurodegenerative diseases.

Issues/Outcomes: The primary issue encountered with this study in 2013 were difficulties in sourcing the original PET radiotracer planned to be used in the project, [F18]- PBR111. We have now sourced an alternate, and superior radiotracer, [F18]- FEMPA, to image the TSPO protein. The ethics applications for the pilot clinical study using this new PET tracer have now been submitted (November 2013) and the study should be ready to start recruiting patients early in 2014.

Goals for 2014: To recruit and study the two groups of 10 patients each with either: (1) relapsing-remitting MS who will undergo two [18F]-FEMPA PET scans, during an acute relapse (prior to corticosteroid treatment) and a second scan three months later during remission; or (2) secondary progressive MS who will have a single [18F]-FEMPA PET scan. During PET imaging, patients will have arterial blood sampling for quantification of plasma input function for derivation of [18F]-FEMPA binding potential (BPND). Patients will also have a gadolinium enhanced MRI at each of these time points to allow correlation between the regions of acute contrast enhancement and the [18F]-FEMPA PET uptake. Additionally we will study 10 healthy controls without history of neurological or psychiatric disorders who will undergo an [18F]-FEMPA PET scan.

Nurturing the Vulnerable Brain

CI: Professor Fiona Judd, Department of Psychiatry

Team Members: Professor Ian Everall, Department of Psychiatry, Dr Penny Sheehan, Department of Obstetrics and Gynaecology, Dr Padma Murthi, Department of Obstetrics and Gynaecology, Dr Chad Bousman, Department of Psychiatry, Dr Tram Nguyen, Department of Psychiatry, Professor Lex Doyle, Department of Paediatrics, Professor Louise Newman, Monash University, Dr Kylie Grey, Monash University

Research Project Detail: Maternal anxiety has been shown to have deleterious effects for the neurodevelopment of offspring, including worse perinatal outcomes and long term adverse emotional, cognitive and behavioural effects on the offspring. The mechanism by which the maternal antenatal anxiety affects the in-utero environment is not known. One possibility is through transfer of maternal stress hormones, particularly cortisol, across the placenta and subsequent effects on placental gene expression in the cortisol pathway.

To date, we have been unable to predict who of the many women with a diagnosis of anxiety in the antenatal period will have infants/children with problems as a result of this clinical presentation, and to determine when we should intervene to mitigate this risk. We propose that identification of changes in placental function (e.g. 11ß-HSD2, 11ß-HSD1, CRH, cytokines, homeobox genes) in women with antenatal anxiety will identify the sub-group of infants,

whose mothers are exposed to antenatal stress, who will manifest adverse neurodevelopmental outcomes.

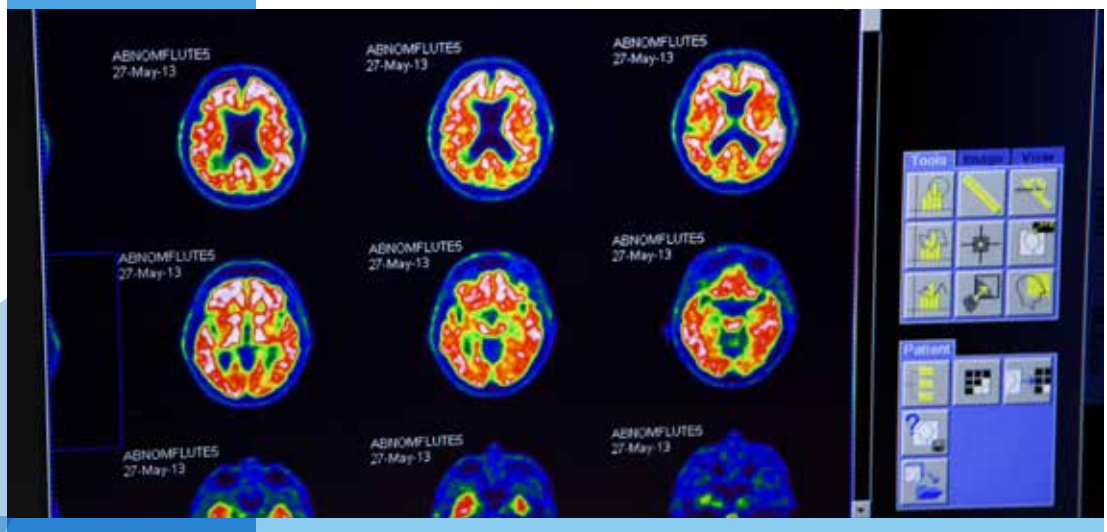
As a first step, we will examine mRNA expression relevant to the cortisol pathway in the placenta of women who have a diagnosis of anxiety during pregnancy using a customised real-time RT-PCR array. The identification of differentially expressed genes in the placenta of women with anxiety will provide evidence for possible biomarkers of poor outcomes in the offspring of women with antenatal depression.

The project involves the collection of placentae from women diagnosed with an anxiety disorder in pregnancy, as well as women without such a diagnosis. Participants will also be asked to complete 3 questionnaires. Women will be recruited from outpatient settings remote from the time of labour and delivery.

Issues/Outcomes: The project suffered some delays in obtaining research and ethics approval due in part to concerns about the content of the questionnaires and the possibility of their causing or increasing anxiety in pregnant women, which took some time and effort to answer satisfactorily although the questionnaires involved are well-validated research tools. Full approval was first obtained in May 2013 with recruitment to the study commencing shortly after.

Goals for 2014: Our first priority for 2014 is to complete the collection of placenta samples. Current collection stands at nine control placentae and four placentae from patients with anxiety. The collection of placentae from patients with anxiety is inevitably delayed by the need to identify these women during antenatal care and then await delivery. We estimate that sample collection should be completed by mid-2014.

Early in 2014 we intend to circulate lists of candidate genes for inclusion on our customised array plates. Although the inclusion of some genes are clearly indicated such as enzymes of the cortisol synthesis pathway (11ß hydroxy steroid dehydrogenase 1 and 2 for example) others require discussion and prioritisation by researchers. We should be able to obtain sufficient pilot data for submission of a grant in the NHMRC 2015 funding round.



Enhanced neuroplastic adaptation to cochlea implants through music training

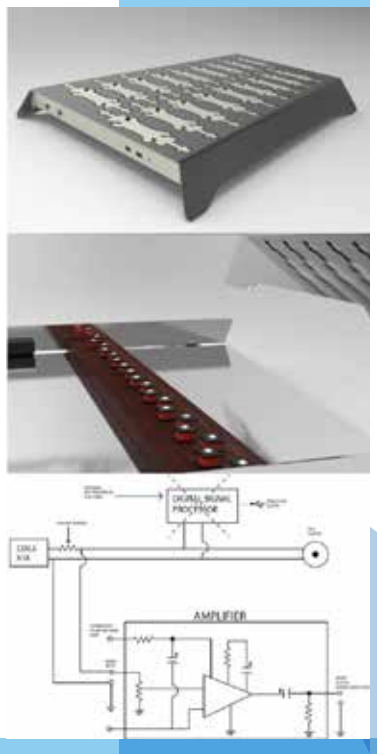
CI: Associate Professor Neil McLachlan, Melbourne School of Psychological Sciences

Team Members: Professor Sarah Wilson, Melbourne School of Psychological Sciences, Professor Richard Dowell, Department of Audiology and Speech Pathology, Dr Jeremy Marozeau, Bionics Institute, Ms Jo Wigley, University of Melbourne

Research Project Detail: It is predicted that a music training program using multi-modal integration of auditory, visual and motor processing will promote rapid and effective learning of auditory skills in adult non-musicians. This intervention can then be used in auditory rehabilitation with people suffering from peripheral hearing loss to improve their auditory perceptual abilities. Specifically, it is expected that the training will improve pitch perception and cognitive skills such as auditory working memory and thereby improve music perception and the ability to comprehend speech in noisy environments. It is expected that these behavioural changes will be associated with neuroplastic changes evidenced by increased amplitude and shorter latency of the multifocal motor neuropathy in the auditory event-related potential waveform as a result of the training.

Over a 12 week period, the intervention will involve four group sessions with the experimenter and a weekly program of learning modules delivered at home via computer-based instructional software. All participants will be provided with purpose-built, tuned percussion instruments (a specially designed electric metalophone) and a tablet or notebook with the instructional software pre-loaded. The metalophones are designed with a pre-set range of notes and do not require tuning. The metalophones will connect to a computer so that interaction with the computer-based learning is enabled and performance can be recorded. The learning design will make use of a graphic music notation and user interface that links shapes and sounds to provide indexical representations of pitch, rhythm and melody that are intuitively and rapidly learnt. Both the instruments and the graphic interface of the training modules are being designed to maximize engagement and learning, enabling participants to develop a deep understanding of musical structure without needing to spend a lengthy period learning to translate the complex symbolic traditional music notation.

Below **A. the refined design, B. electrical coil layout and C. circuit design.**



Instrument Design

An innovative technological solution to recording participant performance using tuned percussion instruments has been implemented for this project. Since acoustic microphones have poor selectivity leading to feedback and background noise, electromagnetic coils have been used instead (as used in electric guitar pick-ups). The metalophones have aluminum keys and so rare earth magnets were inserted in each key near one end to generate a magnetic field that would drive voltage changes in the pick-up coils.

Initial prototypes of the electric metalophones have been built to prove the concept viability and test circuit designs.

Software Design

A unique software interface has been proposed to teach and represent rhythm for participants in this study. Since rhythms are cyclic in time, our graphic representations of rhythm describe temporal structures in cyclic arrays (like clock faces). In a recent pilot, eight year old children were able to create and learn 5-part compositions based on these representations after just 3 hours tuition. These representations have since been used to develop interactive computer software, where they form the basis of a generative grammar of music. These graphic forms are intuitively understood, and enable rapid implicit learning of music through the direct audio-visual-motoric mappings that they evoke.

Goals for 2014: The research design is complete and graduate student Jo Wigley presented her PhD confirmation in December 2013. We will have 6 instruments and the software systems ready for use in the first experimental intervention due to begin in March 2014. Data collection will commence with normal hearing participants to ensure that effective learning occurs in this group before moving on to hearing impaired participants and cochlear implant recipients over the next 2 years.

Melbourne Neuroscience Institute Fellowships

Dr Tobias Merson

Project title:

The oligodendrocyte plays an integral role in brain plasticity throughout life.

Summary of Project:

This project sought to investigate how different neural cell types interact to establish normal brain anatomy. Specifically, Dr Merson focused on the interaction between a type of glial cell called an oligodendrocyte which produce processes that wrap around and insulates the axons of neurons, enabling rapid electrical signalling. This research is of interest because understanding how these cells interact will provide us with essential insights into how the brain functions in an efficient and adaptable manner.

Outcomes:

The study has provided fascinating new insights into the cellular processes responsible for establishing the unique topography of oligodendrocytes in white matter. White matter oligodendrocytes are distributed either as isolated cells or as linear arrays in conjunction with other glial cells including astrocytes and microglia. The specific arrangement of oligodendrocytes is established by a combination of random rearrangement and proliferation of isolated progenitor

cells that give rise to groups of oligodendrocytes in tandem alignment. The same process is responsible for the regeneration of myelin occurs after experimental demyelination, which models the degenerative and regenerative processes that occur in multiple sclerosis. Dr Merson's working hypothesis is that linear arrangements of oligodendrocytes enable myelination of local nerve fibres to be executed in the most efficient manner by optimising the timing of cellular differentiation between adjacent cells. The work has important implications for understanding how specific patterns of myelination restore neuronal function after injury and contribute to brain plasticity in adult life.

Dr Valentina Lorenzetti

Project title:

Craving in problem gamblers: Does brain activity predict gambling later in life?

Summary of Project:

Dr Lorenzetti investigates the neurobiological correlates of problem gambling in association with Electronic Gaming Machines [EGM, or *pokies*], the most prevalent problematic form of gambling that represent 40% of the money spent of gambling in Australia. Dr Lorenzetti's research focused on understanding the how (self-reported and neurobiological) measures of craving and psychophysiological arousal contribute to the maintenance of problem gambling. This issue has key implications for the understanding of the key behavioural phenotypes of the disorder and the development of intervention strategies. Dr Lorenzetti has also focused in developing an interdisciplinary approach for the understanding of problem gambling.

Outcomes:

Dr Lorenzetti is leading a functional Magnetic Resonance Imaging study of Australian problem gamblers who are experiencing problems with EGMs and age and sex-matched controls. Her research project has brought together a multi-disciplinary team of neuroscientists and economist to inform, complement and adjust models of financial decision-making with neuroscientific data for a better understanding of problem gambling. Dr Lorenzetti has also coordinated a workshop for neuroscientists, economists, clinicians and policy makers aimed to improve the translation of outcomes from gambling research to the general community through a University of Melbourne Interdisciplinary Seed Funding grant.

Below 2013 Melbourne Neuroscience Institute Fellows.

Strategic Research Australian Postgraduate Awards

Mr Jeremiah Lim (Commenced 2013)

Summary of research:

Mr Lim's research revolves around the development of a method to detect brain conditions such as Alzheimer's disease by imaging the eye. The eye is a natural extension of the brain and possesses clear optics, making it the perfect place to study neural tissue such as the retina non-invasively. Alzheimer's disease has been shown to deposit hallmarks such as amyloid plaques in neural tissue and blood vessels, leading to eventual loss of function. By using rodent models of the disease, Mr Lim hopes to study the effects of the disease on retinal blood flow, retinal metabolism and retinal function. Mr Lim is in the process of developing a novel platform to image rodent eyes with the disease. Mr Lim hopes to detect markers of the disease in the eye during the early stages of the disease. Any discovery made here would be a step towards the early detection and eventual treatment of the human disease. The image below refers to: A. The eye when excited by light of wavelength 577nm highlights both oxygenated and deoxygenated blood equally. B. In contrast, longer wavelength light such as 605 nm highlights mainly deoxygenated blood. The difference between A and B may be used to quantify the amount of oxygen saturation, which may be used as a marker for neurodegenerative conditions.

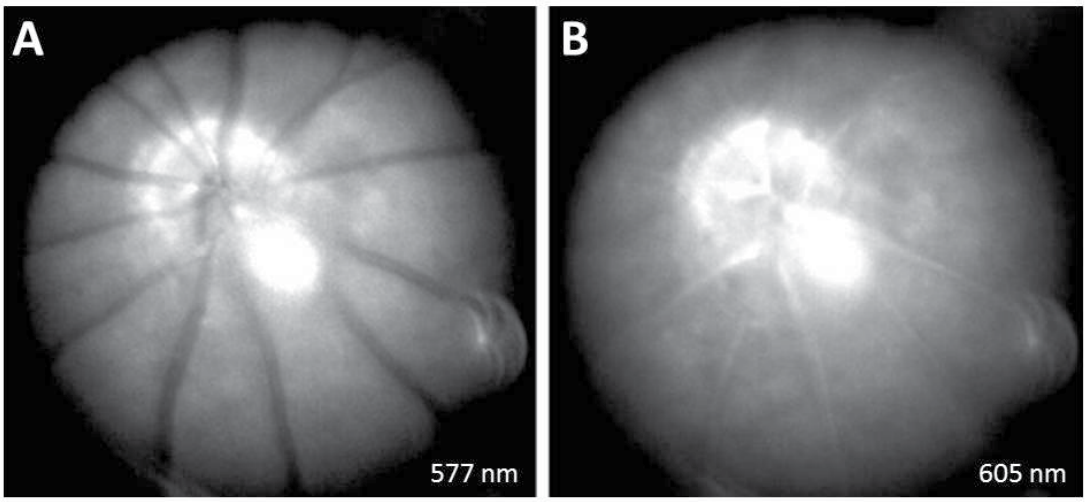
Outcomes:

An early prototype of the imaging platform has been developed and it is currently being tested on normal, healthy rodents.

Goals for 2014:

To extend the imaging platform capabilities to include the quantification of retinal blood flow, retinal metabolism and oxygen consumption in both healthy and diseased rodent eyes. As a full time PhD student and a part-time Optometrist, having the STRAPA means less time at work in the eye clinic and more time at work in the research laboratory.

Below **Imaging the healthy mouse eye.**



Lulu Xing (Commenced 2012)

Summary of research:

The loss of myelin, the insulating coating that surrounds the fibres of nerve cells is a hallmark of several brain diseases including multiple sclerosis. Demyelination occurs when the cells that produce myelin, known as oligodendrocytes, become depleted. To restore function to previously myelinated nerve cells, myelin must be regenerated. It was previously believed that this function was served primarily by a type of precursor cell called an oligodendrocyte progenitor cell (OPC) which has the capacity to mature into oligodendrocytes. We asked the question whether a type of stem cell, called a neural precursor cell (NPC) which has a broader potential to produce different types of neural cells, can also produce new oligodendrocytes following the loss of myelin. Using genetic fate-mapping approach and electron microscopy in an animal model of demyelination, I am investigating the precise role of these two distinct stem cell populations, especially with regard to their relative contribution to oligodendrocyte regeneration and myelin repair.

Outcomes:

Working together with Dr Tobias Merson and Professor Trevor Kilpatrick, our in-vivo genetic fate-mapping studies revealed that NPCs significantly contribute to the regeneration of oligodendrocytes and myelin following toxin-induced loss of myelin, but only in the damaged area proximal to the stem cell niche, where NPCs have a competitive advantage in repairing the lesion over resident OPCs. Our initial analysis of myelin ultrastructure also demonstrated the restoration of normal myelin in the region subject to significant NPC-derived oligodendrogenesis.

Future goals:

Our future work will elucidate the quality of myelin regenerated by these two sources of oligodendrocytes and also determine whether there is functional heterogeneity among NPCs and OPCs. A thorough understanding of stem cell biology in the context of myelination will provide the opportunity for novel therapeutic strategies aimed to re-establish the capacity of endogenous NPCs for regeneration in multiple sclerosis.

“Being supported by the scholarship allows me to focus more on doctoral studies without worrying about financial woes. It also makes me feel more responsible for my pursuit of scientific knowledge.”

Jessica Kauhausen (Commenced 2012)

Summary of research:

Parkinson’s disease (PD) is a neurodegenerative disease that affects 2% of the population over the age of 65 years. There is currently no cure available for PD and whilst current therapies are effective in reducing the severity of symptoms in the short term, in the long term many patients develop serious side effects.

A different approach towards the treatment of PD is to replace the lost dopamine neurons with new, healthy neurons in an effort to restore cell

function, a therapy referred to as cell replacement therapy (CRT). Clinical trials have already shown that CRT can provide an improvement in some patients. However, the high variability seen between patients' needs to be addressed before CRT can be considered a viable treatment option for PD. One cause of the variation is due to the poor integration and growth of the new dopamine neurons within the patient's brain.

The STRAPA supports PhD projects are focussed on providing improved environments for grafted dopamine neurons in order to enhance their integration into the host brain. The results from these experiments could potentially be the key to making CRT a success, thus possibly making it a PD treatment that is an affective long-term option and far more effective than any of the current treatments available.

Outcomes:

Early last year, Jessica published a paper describing how age of donor tissue and the addition of a cue or growth factor known as GDNF can affect a grafts ability to integrate and form appropriate connections in the brain. Jessica and team, found that by using a younger source of dopamine neuron in conjunction with GDNF we can significantly improve graft survival and integration upon transplantation into a mouse model of PD. Furthermore, behavioural testing confirmed that younger donor grafts provided a significant improvement in motor behaviour.

Future goals:

"In the future I hope to travel to other labs and/or attend workshops so that I can learn new techniques that could enhance my current research so that one day I may be able to expand my skills and knowledge into other areas of neuroscience/neurological conditions," said Jessica.

"The STRAPA scholarship has provided me with the unique opportunity to solely focus on my research, thus helping form a solid start to my research career."

Below **An overview of a dopamine cell transplant in a mouse model of Parkinson's disease.**

Governance

Advisory Board

The Advisory Board aims to ensure the Melbourne Neuroscience Institute is aligned with important trends and provide avenues for interaction with those who might wish to commission or undertake research through collaborative interaction in the Neurosciences and related disciplines of research at the University. Board members have strong credentials in the University of Melbourne, private, public and non-government sectors and act as advocates on behalf of the Melbourne Neuroscience Institute.

The Melbourne Neuroscience Institute Advisory Board provides advice on:

- Research directions of themes and projects within Melbourne Neuroscience Institute
- Business strategies to ensure the Melbourne Neuroscience Institute operates in a manner consistent with industry best practice, for the benefit of Melbourne Neuroscience Institute staff and researchers
- Stakeholder linkages and improvements to encourage participation and mutually beneficial outcomes for Melbourne Neuroscience Institute researchers.

Membership

Chair: Professor Liz Sonenberg (Pro Vice-Chancellor (Research Collaboration))

Members	
Representative	**Title**
Professor Glenn Bowes	Associate Dean (External Relations), Faculty of Medicine, Dentistry & Health Sciences
Professor Richard Head	Director, Sansom Institute for Health Research, UniSA
Professor Janet Hergt	Acting Dean, Faculty of Science
Professor Trevor Kilpatrick	Director, Melbourne Neuroscience Institute
Dr Andrew Milner	CEO, Neurosciences Victoria
Professor Greg Qiao	Assistant Dean (Research), Melbourne School of Engineering
Professor Stephen Smith	Dean, Faculty of Medicine, Dentistry & Health Sciences

The Melbourne Neuroscience Institute would like to extend thanks to our retiring Advisory Board members for their superb leadership and guidance.

Retiring Members	
Representative	**Title**
Professor James Angus	Dean, Faculty of Medicine, Dentistry & Health Sciences
Professor Rob Saint	Dean, Faculty of Science

Scientific Consultative Forum

The Scientific Consultative Forum is a grouping of Department Heads or their delegates who assist the Melbourne Neuroscience Institute by providing a coordinated vision for the award of core research support funds provided by Melbourne Neuroscience Institute and in addition to provide key strategic advice, ancillary to that provided by the Melbourne Neuroscience Institute Advisory Board.

Membership

Chair: Professor Trevor Kilpatrick (Director, Melbourne Neuroscience Institute)

Members	
Representative	**Title**
Professor Andrew Allen	Department of Physiology
Dr Chad Bousman	Department of Psychiatry
Ms Amy Bugeja	Melbourne Neuroscience Institute
Professor Sam Berkovic	Department of Medicine
Professor Roberto Cappai	Department of Pathology
Professor James Camakaris	Department of Genetics
Dr Gursharan Chana	Department of Psychiatry
Professor Mark Cook	Department of Medicine, St Vincent's Hospital
Professor Trish Desmond	Department of Radiology
Professor David Gardner	Department of Zoology
Professor Daniel Hoyer	Department of Pharmacology and Therapeutics
Professor Janet Keast	Department of Anatomy & Neuroscience
Professor Terence O'Brien	Department of Medicine, Royal Melbourne Hospital
Associate Professor Andrew Metha	Melbourne Neuroscience Institute
Dr Bryony Nayagam	Department of Audiology and Speech Pathology
Professor Ingrid Scheffer	Department of Medicine, Austin Health
Professor Philip Smith	Melbourne School of Psychological Sciences
Professor Ann Turnley	Neurosciences and Behavioural Sciences Domain
Ms Trish Weston	Melbourne Neuroscience Institute

Community Consultative Forum

The Community forum provides affiliates, members of the public, school teachers, research representatives and University advancement and alumni representatives with a forum for dialogue, consultation and resolution of issues concerning the public outreach program of the Melbourne Neuroscience Institute.

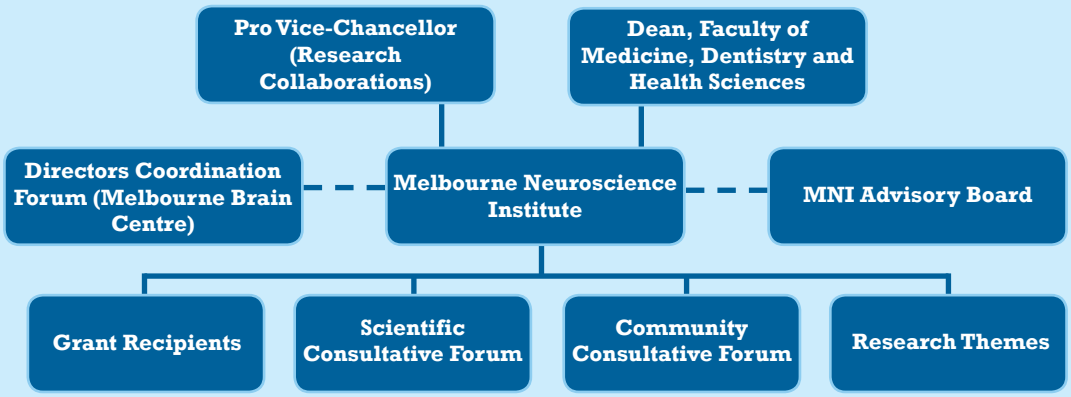
The Melbourne Neuroscience Institute recognises the value of listening to the community and also places considerable emphasis on the need to work closely with other members of the Parkville Precinct. Part of our organisational focus includes embedding the fundamentals of collaboration, consultation and co-design into all of our interactions with the community. This involves fostering partnerships with representatives of the community to develop and implement public programs that meet the expectations of both the community and internal stakeholders.

Membership

Chair: Professor Trevor Kilpatrick (Director, Melbourne Neuroscience Institute)

Members	
Representative	**Title**
Soula Bennett	President, Science Teachers' Association of Victoria
Liz Brentnall	Advancement and Alumni, FMDHS
Amy Bugeja	Project Officer, Melbourne Neuroscience Institute
Carolyne Cohn	Secretary, University of the Third Age
Irene Evans	seminar attendee
Russell Evans	seminar attendee
Lynn Gray	MS Careers Coordinator, Methodist Ladies' College
Christopher Jones	The University High School
Associate Professor Andrew Metha	Deputy Director, Melbourne Neuroscience Institute
Associate Professor Megan Munsie	Head – Education, Ethics, Law & Community Awareness Unit, Stem, Cells Australia
Leonie Ososwski	seminar attendee
Francis Ososwski	seminar attendee
Trish Weston	Operations Manager, Melbourne Neuroscience Institute
Professor Sarah Wilson	Director, Music, Mind and Wellbeing

Melbourne Neuroscience Institute Structure



Finance

The Melbourne Neuroscience Institute receives funding each year from the Deputy Vice-Chancellor (Research) to support research enabling activities such as interdisciplinary research projects in the neurosciences, workshops and seminars, Post-doctoral Fellowships and the development of research partnerships and collaborative grant applications. This funding also supports the core administrative activities of the Institute.

2013 Financial Report

Income ***University Funding***	
Core funding – Institute (DVCR)	$1,040,000
DVCR support-space	$30,000
Sundry income	$703
	$1,070,703

Expenditure ***Research Enabling***	
Interdisciplinary Research Project Seed Funding	$210,000
Melbourne Neuroscience Institute Fellowships	$100,000
Melbourne Neuroscience Institute Research theme support	$20,000
Collaboration and Partnership development	$7,412
PhD student support – scholarships and workshops	$29,300
Sponsorships and donations	$10,455
Seminars and Workshops	$18,430
Melbourne Brain Centre Collaboration Activity	$8,002
	$403,599

MNI Core Administration	
Melbourne Neuroscience Institute staff salaries	$498,059
Melbourne Neuroscience Institute administration & general expenses	$23,622
Events and communications	$15,662
	$537,343

Total Expenditure	$940,942
Balance @ 31/12/2013	**$129,761**

The Melbourne Neuroscience Institute holds carry forward funds from previous years that will be used for further research enabling activities over the period 2014–2016.

The Deputy Vice-Chancellor (Research) and the Faculty of Medicine, Dentistry and Health Sciences provide support to a number of Melbourne Neuroscience Institute-supported research themes. In 2013, funding was provided to Stem Cells Australia as the University's contribution to the ARC-funded project under the Special Research Initiative in Stem Cell Science to support the Stemcore platform, the Chair in Stem Cell Sciences and the education, ethics and community awareness program. Funding was also provided for the strategic development of the Melbourne Brain Centre Imaging Unit to support the position of Chair of Imaging Sciences.

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