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**Brain and Mind Centre**

Annual Report 2015-16

The University of Sydney

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patients'  
success  
is our  
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# Brain and Mind Centre

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THE UNIVERSITY OF  
**SYDNEY**

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# Welcome Co-Directors

Welcome to the Brain and Mind Centre Annual Report, which celebrates our many achievements over the past two years.

Becoming Brain and Mind Centre in 2015 marked a radical shift in direction towards developing into a truly multidisciplinary centre that encourages participation from research teams across the University of Sydney campuses at Camperdown and Mallet Street, Westmead, Nepean, Cumberland and beyond. By entering into our network, researchers have access to information on relevant funding opportunities, news, and events. They also have the opportunity to partner with other research institutes, local health districts, government, industry and the community.

Most importantly, our researchers are working as part of an academic community that is focused on finding solutions to the most challenging health problems in the world. Our unique approach combines effective clinical care with cutting-edge research, providing researchers with live data and giving clinicians access to innovative treatments and interventions as soon as they are developed. We encourage researchers to join us in our multidisciplinary approach to tackling the challenges of brain and mind disorders.

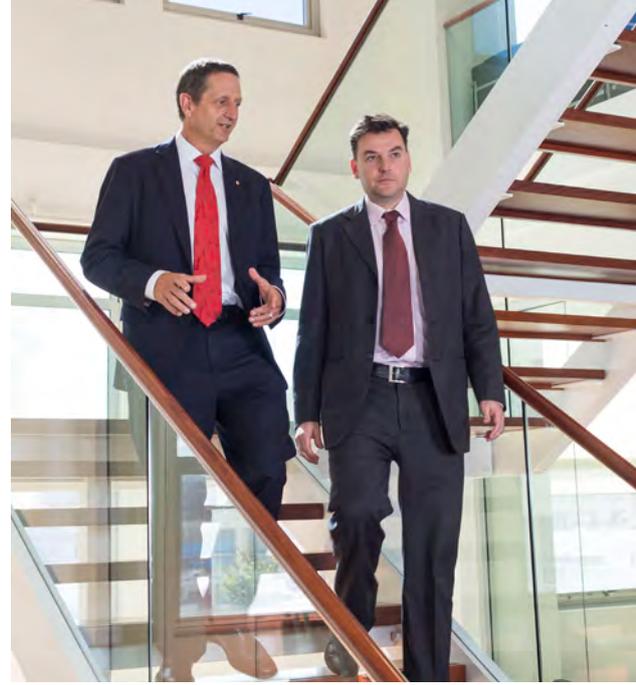
As part of this emphasis on growing our research potential, we welcome the arrival of ForeFront, led by Professors Glenda Halliday, John Hodges and Associate Professor Olivier Piguet. This team is committed to discovering early detection methods, identifying new treatments and understanding the underlying mechanisms of neurodegenerative disease. We are also proudly watching the progress of the Lambert Initiative, formed in 2015 after an unprecedented personal donation to support research into the use of medicinal cannabis.

We welcome Professor Markus Leweke to the role of Chair of Youth Depression Studies. Joining us from the Central Institute of Mental Health in Mannheim, Germany, Professor Leweke plans to work closely with the Sydney Local Health District to set up a clinical service unit at the Marie Bashir Centre. Another appointment to celebrate is Niels Buus to the St Vincent's Chair of Mental Health Nursing, who will work to develop new family and community-based models of mental healthcare.

The vast amount of peer-reviewed papers highlighted in this publication is testament to the tireless work of our researchers who have won many grants over the past two years. Our work has been noticed nationally too – Prime Minister Malcom Turnbull committed \$30 million to Project Synergy in 2016. This project is led by Professor Jane Burns, a relentless innovator in the field of digital mental health.

To help communicate our successes and to further boost our profile, as well as making our patient services more accessible, we have redeveloped our website and social media.

We hope you enjoy this publication and look forward to our continued successes.



Our Co-Directors Professors Ian Hickie (Left) and Matthew Kiernan.

*Matthew Kiernan*

**Professor Matthew Kiernan**  
Co-Director, Translation and Discovery

*Ian Hickie*

**Professor Ian Hickie AM**  
Co-Director, Health and Policy

# Welcome

## Message from the University

The University of Sydney officially launched Brain and Mind Centre in July 2015 to address disorders of the brain and mind, expand the breadth and depth of multidisciplinary research and set new standards in brain and mind sciences, both in Australia and internationally.



Professor Duncan Ivison  
Deputy Vice-Chancellor, Research  
University of Sydney

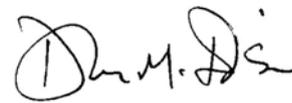
Previously known as the Brain and Mind Research Institute (BMRI), the Centre was created as a flagship multidisciplinary initiative, one of the key recommendations of the Health and Medical Research Strategic Review. The aim: to leverage the University's existing research excellence in order to deliver significant benefits to society.

With Co-Directors Professors Matthew Kiernan and Ian Hickie leading the way, Brain and Mind Centre is breaking new ground in research and development. We are excited to present a snapshot of this incredible research conducted throughout 2015 and 2016.



Professor Laurent Rivory  
Pro Vice-Chancellor, Strategic  
Collaborations and Partnerships  
University of Sydney

The Centre's strategic objectives are focused on creating an enduring program of research and education that responds directly to 21st century societal challenges of the brain and mind sciences.



**Professor Duncan Ivison**  
Deputy Vice-Chancellor, Research  
University of Sydney



**Professor Laurent Rivory**  
Pro Vice-Chancellor, Strategic  
Collaborations and Partnerships  
University of Sydney



# Overview

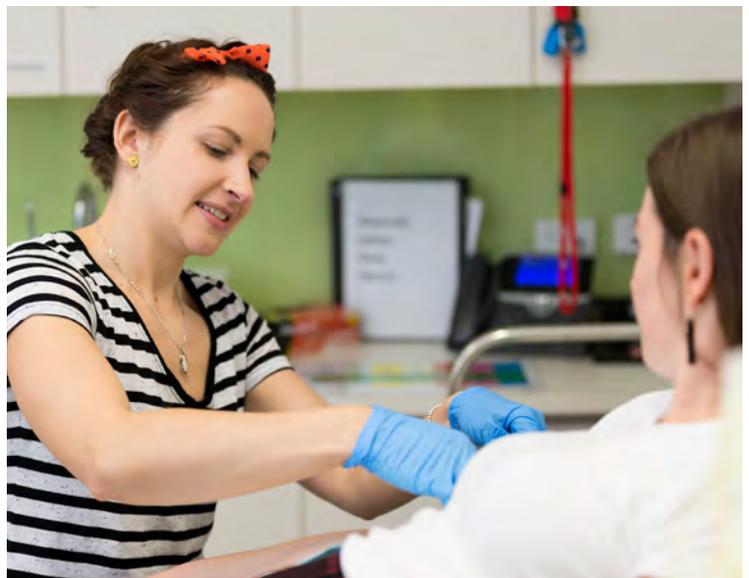
## Teams and key research themes

The University of Sydney's Brain and Mind Centre is a global leader in research into, and treatment of, disorders of the brain and mind. Our vision is to see a world where people can reach their full potential and play an active role in society.

Our multidisciplinary research teams are at the forefront of brain and mind sciences. We work to find answers to some of the world's most pressing health concerns, including childhood development and behaviour disorders, youth mental health and addiction, and ageing and neurodegeneration such as dementia, multiple sclerosis and Parkinson's disease.

Our large-scale research is collaborative and innovative, our laboratories are state-of-the-art and our clinics are a valuable resource for people in need. Our visionary research teams partner with the community, industry, government and diverse branches of academia to make a real difference to people's lives.

Brain and Mind Centre represents a virtual network of academics across University of Sydney, Westmead Hospital, Nepean Hospital, Royal North Shore Hospital, Kolling Institute, Concord Repatriation General Hospital and Sydney Adventist Hospital. The Centre is also affiliated with Sydney Health Partners and Sydney local health districts.



Testing at the Autism Clinic for Translational Research.



Partnering with patients to find solutions to world health problems.

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Teams and Key Research Themes

# Overview

## Partnerships

Our cutting-edge research is underpinned by strategic partnerships. New solutions to help people in need require new collaborations - few medical discoveries are made in isolation.

Brain and Mind Centre is uniquely positioned for translational research that makes a real difference to people's lives. Our dedicated laboratories are co-located with clinical services. This means we can integrate cutting-edge research with safe and effective clinical care. We leverage our research capacity by joining forces with the community, healthcare providers, industry, government and researchers from across the world to provide the best possible outcomes for people affected by brain and mind disorders.

### Connecting with the community

We pride ourselves on partnering with the community to inform our research. We work directly with patient communities to provide expert clinical care and partner with organisations such as MS Australia and Parkinson's NSW to ensure our expertise is available to those who need it most.

Our Youth Mental Health team works closely with headspace, the National Youth Mental Health Foundation, providing early intervention and mental health services for 12 to 25 year olds. The Camperdown headspace clinic is located at Brain and Mind Centre, facilitating continuous improvements to mental health services for the benefit of young people across Australia.

### Partnering with industry

Brain and Mind Centre works closely with a variety of progressive companies to translate new technologies and research discoveries into innovations that benefit the economy and society. By bringing together research expertise with commercial clout, cutting-edge treatments for brain and mind disorders can reach the people that need them.

Our multiple sclerosis research group has established successful partnerships with Novartis, Biogen and Sanofi Genzyme, leading to funding for research trials and patient access to new drugs.

Similarly, our Youth Mental Health team has partnered with PricewaterhouseCoopers to develop InnoWell, a new company championing digital healthcare.

We are proud to partner with Southern Radiology, one of Australia's largest medical imaging providers. By working with their team of specialist diagnostic imaging radiologists, we can pool our resources and work together to study changes that occur in the brain.



Professor Ian Hickie AM with researchers in our Youth Mental Health and Technology team.

### Working alongside health services

We work closely with the Sydney Local Health District, Northern Sydney Local Health District, Western Sydney Local Health District and the Sydney Children's Hospitals Network, all of which are part of Sydney Health Partners, a collaboration between the University of Sydney and its affiliated medical research institutes. In 2015, Sydney Health Partners was recognised as a National Health and Medical Research Council Advanced Health Research and Translation Centre – one of only four in Australia.

### Collaborating with a global academic network

Our researchers partner with fellow academics, institutes and universities from across Australia and the world. By sharing knowledge, resources and facilities, we offer the best chance of finding solutions to some of society's greatest health challenges. We are part of the Group of Eight (Go8) in Australia, a coalition of research-intensive Australian universities and their affiliates, as well as leading institutions from across the world.

We also work closely with the Woolcock Institute. In 2016, the Woolcock NeuroSleep Clinic was established and is now located at Brain and Mind Centre's Camperdown site to advance research in translational sleep and circadian neurobiology.

Similarly, the Cerebral Palsy Alliance Research Institute employs a number of researchers across disciplines, dedicated to improving outcomes for patients. In 2015, Cerebral Palsy Alliance formed an affiliation with the University of Sydney and a branch is now located at Brain and Mind Centre's Camperdown research site.

# Child Development and Behaviour

—

Enhancing children's wellbeing  
to prevent problems in later life.

# Child Development and Behaviour

## Our core business

Our team brings together internationally regarded clinical researchers in child development to reduce the impact of vulnerabilities such as social problems, autism, disruptive behaviour, emotional problems and impulsivity/hyperactivity.

### Enhancing children's wellbeing

Our clinical researchers specialise in developing innovative assessments and treatments for child mental health. At the same time, we work to identify the mechanisms that contribute to vulnerability, resilience and development in children and their families.

The team is led by child psychologists Professors Mark Dadds and Adam Guastella, and Associate Professor David Hawes.

### An individualised approach to child mental health

Rather than working within rigid diagnostic categories (such as autism, conduct disorder, anxiety or attention deficit hyperactivity disorder), we assess children who present with a broad range of emotional and social development concerns and design the most effective intervention based on the unique needs of each child.

We recognise that there is significant overlap among many mental health conditions in childhood. Our approach provides a more effective way to prevent and manage mental health concerns in children.

### A neurobiological focus

We investigate key neurobiological markers (that is, biological characteristics) of emotional, behavioural and social problems in children.

This knowledge of biological markers means we can more effectively identify which children benefit from different types of treatments, as well as understand and track how these treatments improve outcomes.

### A focus on positive parenting and families

Many of the best evidence-based interventions for child mental health problems work by engaging with families. Our work is centered on building resources in parents and families to help foster healthy development and overcome early-onset problems in children. Our team has developed and evaluated brief evidence-based parenting interventions that create optimal environments for positive child development.

Professor Adam Guastella demonstrates the MRI scanner.



# Child Development and Behaviour Highlights

## A new team is born

2015 saw the appointment of Professor Mark Dadds to Brain and Mind Centre. As the Principal Research Fellow at the National Health and Medical Research Council (NHMRC), Professor Dadds is a distinguished leader in clinical child psychology, specialising in early intervention and the prevention of mental health problems.

Professor Dadds' research focuses on the development of novel treatments for children and young adults with behavioural and emotional problems. His appointment has strengthened Brain and Mind Centre's existing research and clinical capacity in the area of childhood mental health.

The formation of the Child Development and Behaviour Team brings together the expertise of Professor Mark Dadds, Professor Adam Guastella, Associate Professor David Hawes and their research groups, in a collaborative program of research.

## Opening the Child Behaviour Research Clinic

The Child Behaviour Research Clinic (Co-Directed by Professor Mark Dadds and Associate Professor David Hawes) is a state-of-the-art, custom-designed research clinic focused on developing, evaluating and disseminating novel treatments for young children with behavioural and emotional problems.

The Child Behaviour Research Clinic was officially opened in 2016 by former federal minister for health and aged care, Sussan Ley. The Clinic represents Brain and Mind Centre's commitment to shaping the next generation of mental healthcare for young people.

## New therapies for autism

In a world-first, Professor Adam Guastella, NHMRC Career Development Fellow, has used a randomised controlled trial to show the potential benefit of a medication to improve social responsiveness in young children with autism. Currently, autism affects one in 88 Australians.

In this groundbreaking study, oxytocin was administered intra-nasally and found to be well tolerated in young children with autism. Parents reported their children to be more socially responsive at home. Blind independent clinician ratings also supported improved social responsiveness in the clinic.

The trial has been expanded to include larger trials of longer acting oxytocin therapies. This research could represent a major advance in the development of medical treatments for the social deficits that characterise autism.





Child Development and Behaviour team Leaders: Professor Mark Dadds, Professor Adam Guastella, and Associate Professor David Hawes.

## Successful research grants

In 2016, Professors Dadds, Guastella and Associate Professor Hawes successfully led four NHMRC Project Grant applications, attracting a total of \$4,035,340 in research funding. These were:

- oxytocin enhancement of social learning in the treatment of toddlers with autism
- mapping the specific pathways to early-onset mental health disorder
- an integrated model of environmental, neurodevelopmental and epigenetic resistance and responsiveness to early intervention in childhood psychopathology
- a randomised controlled trial of oxytocin nasal spray for alcohol dependence.

This team was also successful in obtaining additional research grants. These include:

### Like Father Like Son: a national approach to violence, antisocial behaviour and the mental health of men and boys

**Led by:** Dadds, M. and Hawes, D.

**Granting body:** Movember Foundation Award

**Years:** 2015–17

**Amount:** \$2,634,400

### Transgenerational cycles of violence model in Timor-Leste

**Led by:** Silove, D., Rees, S., Steel, Z., Tol, W., Eapen, V. and Dadds, M.

**Granting body:** NHMRC Project Grant

**Years:** 2015–19

**Amount:** \$843,495

### The role of oxytocin in attachment patterns and socio-emotional development

**Led by:** Eapen, V., Silove, D., Dadds, M., Barnett, B. and Kohlhoff, J.

**Granting body:** ARC Linkage Grant

**Years:** 2016–19

**Amount:** \$192,000

## Award-winning researchers

In 2015, Professor Dadds was awarded the Distinguished Career Award from the Australian Association of Cognitive and Behaviour Therapy.

In 2016, Professor Dadds was also made an Inaugural Honorary Fellow of the Australian Association of Cognitive and Behaviour Therapy, and received the inaugural Media Award for Public Engagement with Psychological Science from the Australian Psychological Society.

## The ParentWorks program

In 2016, our team launched the ParentWorks program, Australia's first online, nationally available, evidence-based, father-friendly parenting program. Professor Mark Dadds is leading a team of chief investigators to increase participation of fathers in parenting programs. These programs are known to be most effective when both parents are involved. ParentWorks is part of the 'Like Father Like Son' national initiative.

The program incorporates videos and homework, and features such as an interactive child behaviour tracker that has been developed to improve parenting skills, confidence and child behaviour. The online platform also incorporates a list of resources available for families who require face-to-face support during or after the program.

To find out more, go to:

- [www.parentworks.org.au](http://www.parentworks.org.au)

## Partnering with Cerebral Palsy Alliance

The Cerebral Palsy Alliance research program aims to prevent and cure cerebral palsy as well as find innovative new treatments and interventions. Their researchers work across disciplines to conduct cutting edge research and translate research findings into practice. In 2015, this research institute formed an affiliation with the University of Sydney's Brain and Mind Centre.

# Child Development and Behaviour

## Key projects and clinical trials

### Key research projects

#### Understanding influence of nasal oxytocin agonists on the human brain

**About:** This study uses brain imaging technology to track exactly where oxytocin is delivered to the human brain via nasal spray.

**Collaborators:** Australian Nuclear Science Technology Organisation, Pastorus and Curve Technology.

**Funding:** ARC Linkage

#### A longer acting oxytocin agonist targeting melanocortin pathways to improve social cognition in autism

**About:** This is the first study in the world to apply a new melanocortin drug which acts as a potent oxytocin agonist to treat social impairments in autism.

**Collaborators:** Simons Foundation (New York) and Palatin Technology.

**Funding:** Simons Foundation (New York)

#### Immune markers of social development in autism

**About:** This program of research is gradually demonstrating key immune profile links with autism symptoms in the hope of developing an understanding of potential causes and treatments for autism in early development.

**Collaborators:** Westmead Children's Hospital and Telethon Kids Institute.

**Funding:** Internal



### Clinical trials

#### E-health behavioural family interaction program for treatment of conduct problems in children

**Australian Clinical trials registry number:** ACTRN12612000191897

**Collaborators:** NHMRC and Royal Far West

**Contact:** Professor Mark Dadds

#### The efficacy of emotional engagement treatment in reducing disruptive behaviour in children with oppositional defiant disorder or conduct disorder with callous-unemotional traits

**Australian Clinical trials registry number:** ACTRN12612000155897

**Collaborators:** Nil

**Contact:** Professor Mark Dadds



# Child Development and Behaviour

## 2017 and beyond

We strive to become a major centre for innovation in child mental health. To this end, we plan to bring together our expertise in autism and child behaviour under one roof, to create a transdiagnostic clinical service and research hub. This new child facility will provide a research platform that is both neurobiologically and clinically informed. In turn, this will help us develop personalised approaches to assess and treat children in need.

Over the next 18 months we also plan to develop a number of innovative clinical trials that target mental ill-health in young children. Collaborating with University of Sydney, Westmead Children's Hospital, Royal Far West and local health districts is central to making this happen and we look forward to establishing these strategic partnerships.

Developing a national program to disseminate our treatment strategies is also central to our goals. As is contributing these learnings to influence government policy.





## Patient spotlight

### Hayden's story

Hayden was diagnosed with Autism Spectrum Disorder when he was two years old. For much of his life, he has been trapped in his own world and unable to communicate. His mum Christine spent years trying behavioural and speech therapy, special diets and an array of medications. However nothing made a difference. Christine began to accept that little could be done to help her son participate in everyday life.

“Hayden thought he was an island. He didn't want to be in a group or participate, he wouldn't even sit down in a circle. Everyone thought he was either strange or naughty,” explains Christine.

Therapy was slow and painful. Christine felt like it was getting nowhere. “Even a small transition or change in activity would result in a tantrum. He didn't trust me or anyone trying to help him.”

Christine took it upon herself to research autism and find information on the latest treatments. After contacting multiple paediatricians, she was directed to the Brain and Mind Centre. It was there she was told about a new trial for autistic children. It seemed manageable for Christine and was tailored to her son's individual needs.

This Brain and Mind Centre trial was a turning point in Hayden's life. Oxytocin was the focus of the study and he responded very well to it.

“It was the first time Hayden was really able to engage and became aware that he was not the only person in the room,” explains Christine. “Now when he knocks things over he says, ‘oops,’ and fixes it, whereas before he had tunnel vision and wouldn't have even noticed.”



Hayden.

Hayden's engagement and communication with his family and peers continues to improve. And Christine is learning more about her son every day. “I had no idea that Hayden was aware of his surroundings until he started saying things like, ‘Oh, I like that car,’” says Christine. “When he said, ‘I hate you,’ for the first time I popped champagne because it was the first time he was able to express his emotions in context.”

This Brain and Mind Centre treatment has enabled Hayden to make friends, sit quietly and learn new things at school. He reaches new milestones all the time and often surprises the people around him. Recently he was even able to go on camp by himself for three nights.

“The changes I saw from the trial completely changed the way that Hayden engaged. He wanted to be a part of a group, he didn't fight and his language and social skills improved,” says Christine.

“The changes I saw from the trial completely changed the way that Hayden engaged.”

**Christine**  
Mother of Brain and Mind Centre patient Hayden.

## Research spotlight

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### Dr Laura Ospinas, psychiatrist, youth mental health

Dr Laura Ospinas, a youth mental health psychiatrist from Colombia, is undertaking her PhD with researchers at Brain and Mind Centre. She was awarded the scholarship for PhD studies abroad from the Colombian Department of Science, Technology and Innovation (COLCIENCIAS), the most competitive scholarship for higher degree students in Colombia.

“Being awarded this scholarship is a real source of pride. It is not only an honour, but also a great responsibility, coming from a country with only a few female doctorates,” says Laura.

Laura’s research aims to understand how technology can improve young people’s health and wellbeing, both in Australia and internationally. “A big component of my research is developing, translating and culturally adapting these technological solutions into Spanish, the world’s second most spoken language,” she says. “I strongly believe that technology can help reduce the barriers to accessing mental healthcare in migrant populations as well as in the developing world.”

As a psychiatrist working in youth mental health, Laura says it’s rewarding to see how her team’s efforts can have a real impact on patient outcomes in terms of functionally and social engagement.

“Being here, in this wonderful country, in one of the best universities in the world, and working with my team at the Centre, has opened my mind. I came as a psychiatrist interested in research; now I understand how research can have a real impact in society and on policy, not just locally but internationally and I want to be part of it.”



Dr Laura Ospinas.

**Dr Laura Ospinas**  
Psychiatrist, youth mental health

“I strongly believe that technology can help reduce the barriers to accessing mental healthcare in migrant populations as well as in the developing world.”

# Youth Mental Health

—

Transforming the mental  
health care of young people.

# Youth Mental Health

## Our core business

The Youth Mental Health team puts young people at the centre of their own care. We partner with health services to develop innovative treatments for young people aged 12 to 30 years with emerging mental health disorders.

### A new way forward

We aim to transform how clinical care is delivered to young people with mental health issues. Rather than rely on broad diagnostic generalisations, we want to see clinicians diagnose and treat young people in a way that caters to the individual needs of each person.

We focus on three main streams of research:

- neurobiological: ongoing longitudinal patient studies that allow us to develop and trial new interventions for complex mental health issues
- technology: optimising online environments to deliver services, track progress and provide feedback to young people and their clinicians
- clinical: continuously improving health services for young people by systematically evaluating services.

### Novel interventions

We commenced the Brain and Mind Youth Cohort Study in 2008. Nearly 10 years later, we have assessed 8000 individuals with early phases of anxiety, mood or psychotic disorders. From this cohort we have been able to carry out specific clinical trials of new behavioural, social and pharmacological interventions for these disorders.

Current studies include the youth depression alleviation trial of fish oil (YoDA-F) and oxytocin nasal spray for alcohol dependence.

### Collaboration for better outcomes

headspace is the national youth mental health foundation providing early intervention and mental health services to people aged 12 to 25 years. Our research program is heavily integrated with headspace Camperdown.

The integration of cutting-edge research with safe and effective clinical care enables us to quickly and effectively translate our research findings into clinical services, facilitating continuous improvements to mental health services for the benefit of young people in Australia.





headspace Camperdown clinic at Brain and Mind Centre.

## International networks

Brain and Mind Centre's Youth Mental Health team is one of only three Australian groups to be actively involved in the Motor Activity Research Consortium for Health (MARCH), an international research collaboration to investigate associations between motor activity, mood and related disorders. There are research sites in the USA, Australia, Netherlands, Switzerland, China, Costa Rica, Norway and the UK, all of which are coordinated by the Genetic Epidemiology Research Branch at the National Institute of Mental Health (NIMH) in the United States.

Similarly, we are part of the Enhancing NeuroImaging Genetics through Meta-Analysis (ENIGMA) Consortium, a collaborative network of researchers from around the globe, working together on a range of large-scale studies that integrate data from 70 institutions worldwide. Organised into working groups that tackle questions on neuroscience, genetics and medicine, ENIGMA studies have analysed neuroimaging data from more than 12,826 subjects.



## General mental health

Our broad program of research includes:

- development of novel suicide prevention strategies
- assessment of neurobiological markers of disease using magnetic resonance spectroscopy
- behavioural approaches to the sleep-wake cycle and activity modulation
- personalised approaches to education and employment participation.

# Youth Mental Health Highlights

## Federal government commits \$30 million to Project Synergy

Prime Minister Malcolm Turnbull visited Brain and Mind Centre in June 2016 and announced his commitment to invest \$30 million in Project Synergy over three years (2017–20), as part of his government’s \$192 million mental health policy.

Co-developed by Brain and Mind Centre and Young and Well Cooperative Research Centre, Project Synergy provides young people at risk of suicide with fast access to mental health experts via apps and online tools.

University of Sydney evaluations of Project Synergy trials in Broken Hill, NSW Central Coast and Western Sydney have shown the system effectively identifies young people at risk of suicide and helps them access urgent care from local services such as headspace and Lifeline.

## Welcome Professor Markus Leweke, our new Chair of Youth Depression Studies

At the end of 2016, the University of Sydney appointed Professor Markus Leweke as Brain and Mind Centre’s Chair of Youth Depression Studies. Professor Leweke plans to set up an innovative clinical service model at the Marie Bashir Centre, a purpose built facility designed to help people with mental health issues. The service will assess and monitor patients that present with psychiatric problems over an extended period. The primary goal is to uncover the underlying causes of psychiatric illness.

Professor Leweke’s research provides an alternative to traditional diagnostic categories in mental illness. Rather than symptoms-focused treatment, Professor Leweke hopes to uncover the neurobiological factors that underpin a range of psychiatric conditions by working with integrated inpatient and outpatient facilities.



Professor Markus Leweke, our new Chair of Youth Depression Studies.

## Psychology Clinics join Brain and Mind Centre

In December 2016, Australia's first School of Psychology moved its expanded clinics to Brain and Mind Centre. Mental health research, teaching and community clinics, including counselling, psychiatry and neuroscience are now located in the same space. This co-location of services allows for the provision of best practice and cost effective brain and mind services to the community.

## Gambling Treatment and Research Clinic joins Brain and Mind Centre

The Gambling Treatment and Research Clinic, which sees more than 600 patients per year, received a generous \$1.2 million deed of gift by ClubsNSW over three years (2013–16). This led to the appointment of two doctoral students to carry out a retrospective and prospective evaluation of several programs. These include: an innovative multi-venue self-exclusion program, a joint chaplaincy program with the Salvation Army implemented within clubs, and defining and measuring recovery in gambling.

In 2016, the Clinic's Director, Professor Alexander Blaszczynski, was appointed President of the NSW Psychology Council. Dr Sally Gainsbury also became the Clinic's new Deputy Director and received an Australian Research Council Discovery Early-Career Researcher Award (DECRA) to explore the influence of features of the online environment on risk taking.

Gambling Treatment and Research Clinic.

## Research grants awarded

### Optimising early interventions for young people with emerging mood disorders (Optymise)

**Led by:** Hickie, I., McGorry, P., Christensen, H., Berk, M., Naismith, S., Glozier, N., Burns, J., Guastella, A., Davey, C., Amminger, P.

**Granting body:** the National Health and Medical Research Council (NHMRC) Centres of Research Excellence (CREs)

**Years:** 2014–18

**Amount:** \$2,499,420

### Bridging the gap from the cradle to the mosh pit

**Led by:** Jones, C., Scott, S., Dale, R., Banati, R., Booy, R., Lagopoulos, J., Barnett, M., Hill-Cawthorne, G., Hermens, D., Khandaker, G.

**Granting body:** the Health & Medical Research Strategy SPARC Implementation Fund (the University of Sydney)

**Years:** 2015–16

**Amount:** \$50,000

### Ketamine therapy among patients with treatment-resistant depression

**Led by:** Loo, C., Mitchell, P., Glue, P., Fitzgerald, P., Glozier, N., Lapidus, K., Hadzi-Pavlovic, D., Somogyi, A., Hackett, M., Galvez, V., Rodgers, A. and Mihalopoulos, C.

**Granting body:** NHMRC Project Grant

**Years:** 2016–18

**Amount:** \$606,094

### Men@Work

**Led by:** Harvey, S., Christensen, H., Proudfoot, J., Mitchell, P., Cockayne, N., Santamaria, J., Bryant, R., Glozier, N., Hickie, I., Buchanan, J., Ryan, R., Calvo, R., Bohle, P., Salvador-Carulla, L. and Fernandez Sanchez, A.

**Granting body:** beyondblue research grant

**Years:** 2015–18

**Amount:** \$181,000



# Youth Mental Health 2017 and beyond

## Professor Jane Burns to lead InnoWell

InnoWell is an innovative company bringing digital mental health solutions to the people who need them. The first of its kind in the world, InnoWell brings together the academic rigour of Brain and Mind Centre's mental health expertise and the corporate influence of PricewaterhouseCoopers (PwC).

InnoWell is one of the University of Sydney's largest collaborations with a major corporate backer, leading the way for proven research to translate into real-world outcomes.

InnoWell plans to conduct twelve research trials over four years. In its first year, young people, veterans, post-hospital discharge patients and older Australians will use Project Synergy software to track their mental health. Researchers will monitor their engagement with the program and its effectiveness.

Brain and Mind Centre's role is to ensure the research is of the highest possible standard. As well as to enable access to service users who can both test the platform and provide feedback as part of the research and development process.

The project is a truly joint partnership. Thanks to its corporate backing, there is a clear route to taking the product to scale, with PwC able to expand the project to a mass market. Mental health issues have a clear impact on the economy. By addressing them, we can attain both a social and financial return on investment.



Professor Jane Burns (top left) and the Youth Mental Health team.

# Youth Mental Health

## Key projects and clinical trials

### Key research projects

#### A new clinical staging model for personalised and responsive care

We have successfully developed a new clinical staging model to help clinicians accurately identify the severity of illness in a young person. With this knowledge, options for safer and more effective interventions can be discussed between the young person and their treating team, in line with the stage of illness the young person has.

This approach will help healthcare providers deliver better quality services. As well as assist clinicians to consider the potential trajectory of an illness to better guide support, intervention and service design. It has been implemented in a number of headspace services across the country.

#### Project Synergy – transforming healthcare services

We are using new online technologies to develop highly specialised programs for people with mental health problems. Together with the Young and Well Cooperative Research Centre and supported by the federal Department of Health, we have developed Project Synergy; an innovative e-mental health ecosystem of care for young people. This incorporates a range of complementary apps and web-based interventions to manage wellbeing and mental

health. It uses data collected through digital technologies to promote help-seeking behaviours and, if necessary, facilitate clinical care and engagement with online and face-to-face clinical services.

#### Early success – trialling Project Synergy in Sydney

We have successfully trialled the Synergy platform in five headspace centres across Central and Eastern Sydney Primary Health Network (CESPHN). Young people completed a comprehensive online assessment before entering headspace and Synergy allowed young people and services to see the same health summary information. This resulted in faster detection of suicide risk, quicker access to care, and more accurate treatment planning and allocation of clinical care resources to match the needs of the young person.

Through a participatory design process, clinicians also identified clinical education needs, resulting in training workshops being conducted by researchers to improve service quality and consistency.

#### Brain and Mind Youth Platform

We are developing novel clinical assessment and longitudinal tracking tools using new and emerging technologies to detail psychological, cognitive, social and medical characteristics of depression and plan individualised

and effective long-term interventions. The package of tools is referred to as the Brain and Mind Youth Platform and is supported by the Future Generation Global Investment Company (FGG).

Subscription to the Platform allows access to the same level of detailed clinical assessment and tracking techniques as those currently available only at Brain and Mind Centre. This access to specialist care gives young people the greatest opportunity of achieving recovery from clinical depression.

#### Wellbeing@Work

Led by Professor Nick Glozier from Brain and Mind Centre and researchers at the University of New South Wales, the Wellbeing@Work project, funded by beyondblue, examines how we can use technology to improve wellbeing in the workforce. To do this, we have developed algorithms to assess mental health risk, created online manager training resources, and built a 30 day mental health and wellbeing prevention program.

The project has involved thousands of participants from workplaces including Australia Post, Fortescue Mining, Dairy Farmers and more.

## Clinical trials

### Longitudinal Twin Study

We are leading a large, long-term prospective study of adolescent twins. The project, titled *Can We Predict Who Will Develop Major Mental Disorders: A Long-term Study of Adolescent Twins*, funded by the NHMRC, tracks real-time developmental trajectories of the onset of anxiety and mood, psychotic, or substance misuse disorders through adolescence and young adulthood. Now at the 20-year reassessment mark, the study will determine the extent to which neurobiological and genetic markers can predict outcomes, to help inform the development of novel prevention or early intervention strategies.

### The Fish Oil Youth Depression Study

This team established and conducted the first two sites of *The Fish Oil Youth Depression Study: a Randomised, Double Blind, Placebo-Controlled Treatment Trial*. The NHMRC-funded randomised controlled trial of omega-3 fish oil in young people with major depression ran at headspace Camperdown and headspace Campbelltown.

In December 2016, we completed data collection on 95 patients. The trial is ongoing until 2018 and will run at four other sites in Perth and Melbourne.

**Collaborators:** Professors Paul Amminger, Pat McGorry, Alison Yung, Andrew Mackinnon, Michael Berk and Assistant Professor Chris Davey.

### Ketamine therapy among patients with treatment-resistant depression

In 2016, researchers from Brain and Mind Centre commenced work on a randomised, double-blind, placebo-controlled trial of ketamine therapy among patients with treatment-resistant depression. Funded by an NHMRC project grant, this is the first study of its kind in the world.

In October 2016, the ketamine trial was launched at the Marie Bashir Centre, the first time Brain and Mind Centre research was carried out in conjunction with Sydney Local Health District. The study will trial repeated doses and monitor safety, side effects and implementation issues before treatment is offered to the wider population.

**Collaborators:** Brain and Mind Centre, UNSW, Monash University, University of Western Sydney (UWS), University of South Australia (UniSA) and Alfred Health.



The Professor Marie Bashir Centre.

# Youth Mental Health

## Key publications

1. O’Dea, B., Glozier, N., Purcell, R., McGorry, P., Scott, J., Fields, K., Hermens, D., Buchanan, J., Scott, E., Yung, A., Guastella, A., Hickie, I., et al. (2014). A cross-sectional exploration of the clinical characteristics of disengaged young people in primary mental healthcare. *BMJ Open*, 4(12), 1–8.
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7. Robillard, R., Hermens, D.F., Naismith, S.L., Rogers, N.L., Ip T.K, White, D., Mullin, S.J., Alvares, G.A., Guastella, A.J., Smith, K.L., Rong, Y., Scott, E.M. and Hickie, I.B. (2015). Ambulatory sleep-wake patterns and variability in young people with emerging mental disorders. *Journal of Psychiatry & Neuroscience*, 40: 28–37.
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Professor Nick Glozier

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European Neuropsychopharmacology (2015) 25, 836-845



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## Cluster analysis reveals abnormal hippocampal neurometabolic profiles in young people with mood disorders

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Mood disorders;  
Proton magnetic resonance spectroscopy;  
Glutamate;  
N-acetyl aspartate;  
Myo-inositol

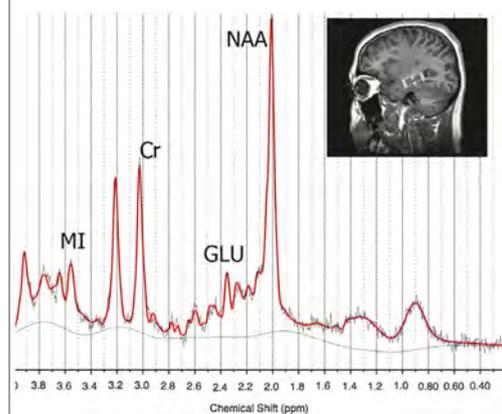
**Abstract**  
While numerous studies have employed magnetic resonance spectroscopy (MRS) to determine *in vivo* neurometabolite levels associated with mood disorders the findings in both unipolar depression and bipolar disorder have been mixed. Data-driven studies may shed new light on this literature by identifying distinct subgroups of patients who may benefit from different treatment strategies. The objective of the present study was to utilize hierarchical cluster analysis in order to generate new hypotheses with respect to neurometabolic profiling of mood disorder. Participants were 165 young persons (18-30 yrs) with a mood disorder and 40 healthy controls. Neurometabolite levels were recorded via proton-MRS (<sup>1</sup>H MRS). The ratios (relative to creatine) of glutamate (GLU), N-acetyl aspartate (NAA) and myo-inositol (MI) measured within the hippocampus. Self-reported and clinician rated symptoms as well as cognition were also measured. The unipolar depression (N=90) and bipolar disorder (N=75) groups did not significantly differ (from each other or controls) in their levels of GLU, NAA or MI. Cluster analyses derived four subgroups of patients who were distinguished by all three metabolites. There was a pattern of positive association between NAA and GLU, whereby clusters were abnormally increased (clusters 1, 2) or normal (cluster 4) or abnormally decreased (cluster 3) in these neurometabolites. These findings suggest that there are neurometabolic abnormalities in subgroups of young people with mood disorder, which may occur despite diagnostic similarities. Such evidence highlights that the underlying neurobiology of mood disorder is complex and MRS may have unique utility in delineating underlying neurobiology and targeting treatment strategies.  
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### 2.1. Clinical assessment

A research psychologist conducted a semi-structured interview to determine the nature and history (including first- and second-



**Figure 1** Water suppressed spectra (sampled from the hippocampus) processed using LCModel from a single representative subject. Abbreviations are as follows: MI=myo-inositol; Cr=creatine; GLU=glutamate; NAA=N-acetylaspartate. Top right panel: Sagittal views of representative T1-weighted images illustrating the voxel placement for the hippocampus (white box).

## Researcher spotlight

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### Ben Trist, PhD student

Ben Trist, a PhD student at Brain and Mind Centre, is investigating the effects of decreasing levels of copper in the brains of patients with Parkinson's disease. In 2016, he won Parkinson's NSW Young Researcher of the Year Award.

Ben's interest in Parkinson's disease partly derives from his first-hand experience of the disease; his grandfather suffered from it. However, it also stems from the influence of his supervisor, Associate Professor Kay Double, who encouraged him to pursue this fascinating area of study. "I have always had an interest in the ageing process and how this process can be determined by an individual's genetic information, but more intriguingly, by their experiences and lifestyle," says Ben.

"I think my award is testament to the importance of the work we as a team are carrying out, and shows that our long hours and hard work are producing results that the scientific community and general public perceive as significant," he adds. "On a more personal level, it has given me a boost of confidence in my abilities as a researcher."

Since commencing with Brain and Mind Centre in 2015, Ben's PhD candidature has progressed smoothly. "The Centre's laboratory and administration facilities have enabled me to mature as a research scientist," he says. "In particular, the microscopy facilities have allowed me to advance my work on human brain tissue pathology, owing largely to the expertise and technical support of Dr Michael Kuligowski."



Ben Trist, PhD student.

### Ben Trist PhD student

"I have always had an interest in the ageing process and how this process can be determined by an individual's genetic information, but more intriguingly, by their experiences and lifestyle."

# Neuroimmunology

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Developing new ways to detect  
and treat neurological disease.

# Neuroimmunology

## Our core business

Our neuroimmunology research focuses on improving our understanding of neurological and psychiatric diseases. It has become clear that many of them are associated with a dysregulation of the immune system.

Autoantibodies are one part of the immune system and are important in many nervous system disorders. In fact, they define certain clinical syndromes. This provides us with an unprecedented opportunity to develop novel diagnostic biomarkers of disease and importantly, develop new and innovative treatments for some of the most debilitating neurological diseases.

Our collective expertise in autoantibody and other biomarker detection, exploration of antibody pathogenicity, neuropathology, imaging and clinical service delivery puts us at the forefront of this research.

Our focus is on identifying and investigating immune and antibody-mediated neurological diseases, including:

- demyelinating diseases such as multiple sclerosis
- motor neurone disease
- psychiatric diseases
- movement disorders
- dementia
- myasthenia gravis and more.

The integration of our basic laboratory research, clinically applied research and health service provision will enable us to readily translate our findings into real world applications.

This research program stems from a collaboration involving a consortium of academics and clinicians from the Westmead Hospital, the Children's Hospital at Westmead, Westmead Institute for Medical Research, Save Sight Institute, Bosch Institute, Royal Prince Alfred Hospital and Concord Hospital.



# Neuroimmunology

## Highlights

### The Sydney Research Excellence Initiative

In 2016, the Neuroimmunology team successfully applied to the Sydney Research Excellence Initiative, a new scheme to support Sydney researchers to test new ideas, push disciplinary boundaries and identify ways to scale up research. The project, titled *Neuroimmunology and Neuroinflammation: From Biomarker and Pathogenesis to Patient Diagnosis and Improvement of Clinical Outcome*, is focused on implementing a neuroimmune service across the University's campuses to support diagnosis and inform clinical care in patients with suspected neuroimmune disorders. The project focuses on investigating mechanisms of neuroinflammation by identifying and validating novel biomarkers to improve long-term clinical outcomes for patients and their families.

### Prizes and awards

Professor Steve Vucic was awarded the Royal Australasian College of Physicians' Eric Susman Prize and the Australian Academy of Science Gottschalk Medal for his pioneering work to identify mechanisms that underlie motor neurone disease (MND). His research has assisted in the development of new techniques for diagnosing MND, resulting in earlier and more effective interventions.

Associate Professor Michael Barnett was awarded a Sydney Research Accelerator (SOAR) Fellowship to identify and develop new and early biomarkers for multiple sclerosis. Professor Barnett is a leader in multiple sclerosis research and has been instrumental in developing a neuroimaging platform at Brain and Mind Centre.

The SOAR Fellowship provides two years of additional research funding for Professor Barnett to continue his work in detecting and monitoring early signs of multiple sclerosis.

### Neurology training

The Australian and New Zealand Association of Neurologists (ANZAN) Neuroimaging and Neuropathology course is an annual training course that has been conducted by Associate Professors Michael Barnett and Michael Buckland for the past four years. Due to its early success, the course is now a compulsory part of advanced neurology training in Australia and New Zealand.

### SNAC collaboration

Our collaboration with Sydney Neuroimaging Analysis Centre (SNAC) has continued to publish high impact multiple sclerosis (MS) imaging biomarker research, which translated to clinical trials in 2015. SNAC, in partnership with industry, has sponsored and co-funded a number of our investigator-initiated research studies to assess clinical and neuropsychological outcomes of existing MS treatments. SNAC also provided infrastructure and expertise to support three PhD candidates in 2015-16.

## Further MS collaborations

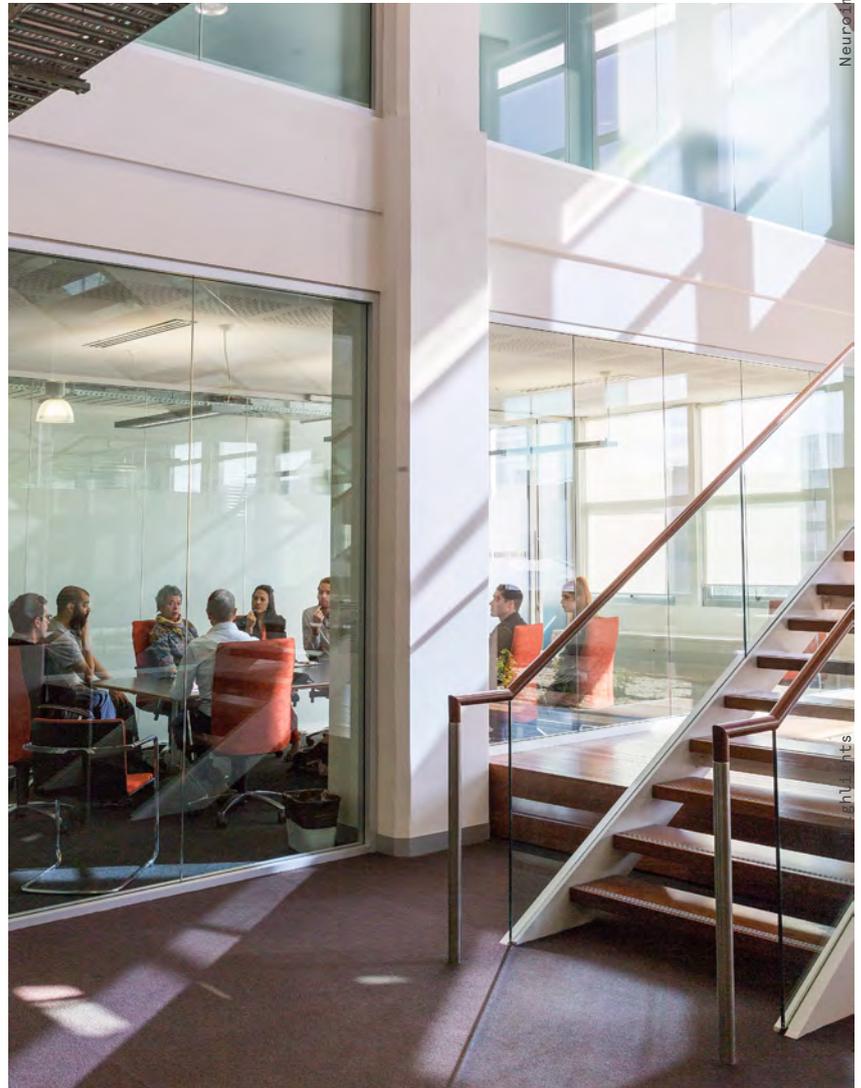
Our dedicated MS clinical trials unit works closely with our multidisciplinary MS Clinic, a 20 year collaboration with MS Limited and Royal Prince Alfred Hospital. In 2015, patients of the MS Clinic participated in more than 10 industry Phase 2 to 4 clinical trials or studies and several investigator-initiated studies.

In 2015, our MS clinicians worked with Sydney Local Health District (SLHD) and Medical Safety Systems to develop and trial an automated safety monitoring system for patients treated with alemtuzumab. In mid-2015, the resulting software platform was adopted for clinical use and has been deployed nationwide.

MS Research Australia Brain Bank, co-directed by Associate Professors Michael Barnett and Michael Buckland and funded by MS Research Australia and SLHD, provided characterised donor MS tissue to researchers in both Australia and the United States.



Dr Heidi Beadnall (right) works with an MS patient.



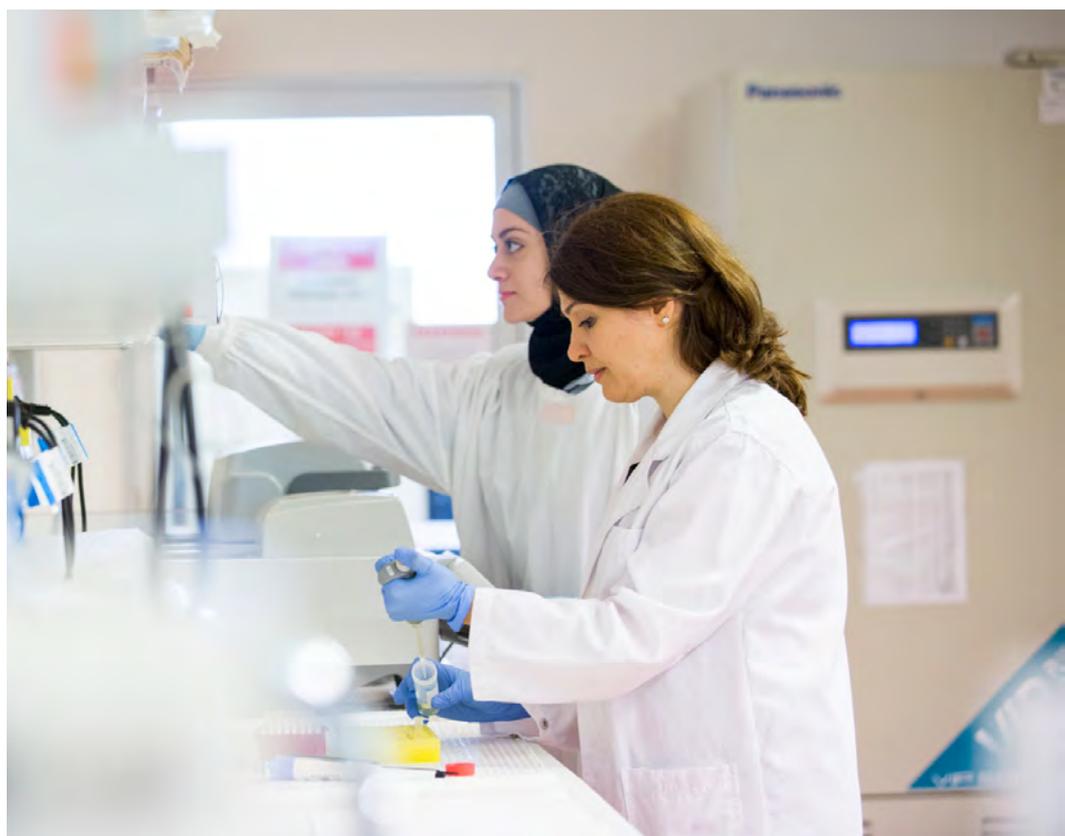
# Neuroimmunology 2017 and beyond

## Statewide brain autoantibody test referral centre

A key goal of the Neuroimmunology team is to establish a statewide brain autoantibody test referral centre. By pooling together existing expertise and infrastructure from across Royal Prince Alfred Hospital, Concord Hospital, Westmead Hospital and Brain and Mind Centre, this collective network of centres will provide patients, clinicians and researchers with a one-stop-shop for neuroimmunology tests.

## 14th International Congress of Neuroimmunology

The International Society for Neuroimmunology's 14th International Congress of Neuroimmunology will take place in Brisbane in August 2018. This huge event attracts experts from across the world and will take place in the southern hemisphere for the first time. Brain and Mind Centre's Neuroimmunology team is heavily involved in organising this conference that will attract a large delegation of experts from across Australia and the world.



Researchers in the neurology laboratory.

# Neuroimmunology

## Key publications

The Neuroimmunology team was built upon an extensive body of ground-breaking research including a number of seminal papers published in the years leading up to the team's founding in 2016.

**In 2012, our researchers made a seminal discovery of D2R antibody in children with movement and psychiatric disorders:**

1. Dale, R.C., Merheb, V., Pillai, S., Wang, D., Cantrill, L., and Murphy, T.K., et al. (2012). Antibodies to surface dopamine-2 receptor in autoimmune movement and psychiatric disorders. *Brain*, (cites 85 WoS/130 GS).

**In 2014, the group discovered a new clinical phenotype in myelin oligodendrocyte glycoprotein (MOG) antibody in demyelinating diseases:**

1. Dale, R.C., Tantsis, E.M., Merheb, V., Kumaran, R.Y., Sinmaz, N. and Pathmanandavel, K., et al. (2014). Antibodies to MOG have a demyelination phenotype and affect oligodendrocyte cytoskeleton. *Neurol Neuroimmunol Neuroinflamm*, 1(1):e12 (cites 44 GS).
2. Ramanathan, S., Reddel, S.W., Henderson, A., Parratt, J., Barnett, M. and Gatt, P., et al. (2014). Antibodies to myelin oligodendrocyte glycoprotein in bilateral optic neuritis. *Neurol Neuroimmunol Neuroinflamm*, (cites 48 GS).

**The team also published the largest and most influential paper on the use of rituximab in children with brain inflammation that has seen 75 citations since 2014:**

1. Dale, R.C., Brilot, F., Duffy, L.V., Twilt, M., Waldman, A.T. and Narula, S., et al. (2014). Utility and safety of rituximab in pediatric autoimmune and inflammatory CNS disease. *Neurology*, 83(2):142-50.

**Our MS researchers and clinicians have also been published widely throughout 2015-16:**

1. Hardy, T., Reddel, S., Barnett, M., Palace, J., Lucchinetti, C. and Weinshenker, B. (2016). Atypical inflammatory demyelinating syndromes of the CNS. *The Lancet Neurology*, 15(9), 967-981.
2. Wang, C., Beadnall, H., Hatton, S., Bader, G., Tomic, D., Silva, D. and Barnett, M. (2016). Automated brain volumetrics in multiple sclerosis: a step closer to clinical application. *Journal of Neurology, Neurosurgery and Psychiatry*, 87(7), 754-757.

3. Barnett, M., Mathey, E., Kiernan, M. and Pollard, J. (2016). Axon damage in central nervous system and peripheral nervous system inflammatory demyelinating diseases: common and divergent pathways of dysfunction and tissue damage. *Current Opinion in Neurology*, 29(3), 213-221.
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6. Klistorner, A., Wang, C., Yiannikas, C., Graham, S.L., Parratt, J. and Barnett, M.H. (2016). Progressive injury in chronic multiple sclerosis lesions is gender-specific: a DTI study. *PLoS One*, Feb 22; 11(2):e0149245.
7. Barnett, M.H., McLeod, J.G., Hammond, S.R. and Kurtzke, J.F. (2016). Migration and multiple sclerosis in immigrants from United Kingdom and Ireland to Australia: a reassessment. III. Risk of multiple sclerosis in UK immigrants and Australian-born in Hobart, Tasmania. *J Neurol*, Apr; 263(4):792-8.
8. Beadnall, H.N., Kuppanda, K.E., O'Connell, A., Hardy, T.A., Reddel, S.W. and Barnett, M.H. (2015). Tablet-based screening improves continence management in multiple sclerosis. *Ann Clin Trans Neurol*, Jun; 2(6):679-87.
9. Broadley, S.A., Barnett, M.H., Boggild, M., et al. (2015). A new era in the treatment of multiple sclerosis. *Med J Aust*, Aug 3; 203(3):139-41.
10. Wang, C., Paling, D., Hatton, S., Lagopoulos, J., Aw, S., Kiernan, M. and Barnett, M. (2015). Axonal conduction in multiple sclerosis: a combined magnetic resonance imaging and electrophysiological study of the medial longitudinal fasciculus. *J Mult Scler*, Jun; 21(7):905-15.

### Antibodies to MOG have a demyelination phenotype and affect oligodendrocyte cytoskeleton

**OPEN**

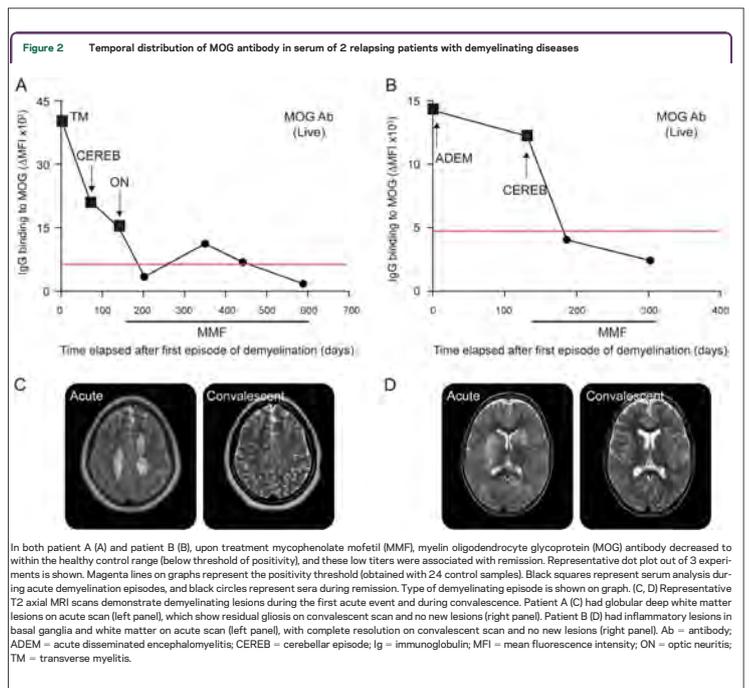
Russell C. Dale, PhD\*, Esther M. Tassin, MBBS\*, Vasa Muehle, BS, Rami Yageta A, Kuanran, BMedSc, Nese Simasi, BS, Kerman Pathmanandavel, MBBS, Sudarshini Ramanathan, FRACP, David R. Booth, PhD, Louise A. Wainhol, PhD, Kristina Prelog, FRACP, Damien R. Clark, FRACP, Giles J. Goldstein, PhD, Chai K. Lim, PhD, Emily K. Mudge, PhD, Fabienne Bellet, PhD

**ABSTRACT**  
**Objective:** To examine the clinical features of pediatric CNS demyelination associated with positive myelin oligodendrocyte glycoprotein (MOG) antibodies and to examine the functional effects of MOG antibody on oligodendrocyte cytoskeleton.  
**Methods:** We measured MOG antibody using a fluorescence-activated cell sorting live cell-based assay in acute sera of 73 children with CNS demyelination (DEM) (median age 8 years, range 1.3-15.3) followed for a median of 4 years. We used MOG.L3 cells to examine immunoglobulin G (IgG) effects on oligodendrocyte cytoskeleton using 3D deconvolution imaging.  
**Results:** MOG antibodies were found in 31/73 patients with DEM (42%) but in 0/24 controls. At first presentation, MOG antibody-positive patients were more likely to have bilateral than unilateral optic neuritis (ON) (SILO = 1.5, respectively,  $p = 0.03$ ), less likely to have brainstem findings (2/31 vs 16/42,  $p = 0.005$ ), more likely to have a raised erythrocyte sedimentation rate  $>20$  mm/h (1/19 vs 3/21,  $p = 0.05$ ), less likely to have intrathecal oligoclonal bands (3/16 vs 5/27,  $p = 0.18$ ), and less likely to be homogeneous or heterozygous for human leukocyte antigen DRB1\*1501 (3/19 vs 7/22,  $p = 0.48$ ). MOG antibody positivity varied according to clinical phenotype, with ON and relapsing ON most likely to be seropositive. Two relapsing MOG antibody-positive patients treated with mycophenolate mofetil remain in remission and have become MOG antibody seronegative. Oligodendrocytes incubated with purified IgG from MOG antibody-positive patients showed a striking loss of organization of the thin filaments and the microtubule cytoskeleton, as evidenced by F-actin and  $\beta$ -tubulin immunolabelling.  
**Conclusions:** MOG antibody may define a separate demyelination syndrome, which has therapeutic implications. MOG antibody has functional effects on oligodendrocyte cytoskeleton. **Neural Immunol Neuroinflammation** 2014;1:1-12. doi:10.1212/NXI.0000000000000012

**GLOSSARY**  
**ADEM** = acute disseminated encephalomyelitis; **AQP4** = aquaporin-4; **CB** = clinically isolated syndrome; **DEM** = demyelinating disease; **EBV** = Epstein-Barr virus; **FA** = fluorescence-activated cell sorting; **HC** = healthy control; **HLA** = human leukocyte antigen; **HA** = human leukocyte antigen; **Ig** = immunoglobulin; **MMP** = matrix metalloproteinase; **MOG** = myelin oligodendrocyte glycoprotein; **MS** = multiple sclerosis; **MOG** = myelin oligodendrocyte glycoprotein; **ON** = optic neuritis; **SNP** = single nucleotide polymorphism; **TM** = transverse myelitis.

Recently, autoantibodies that bind to cell surface antigens have been shown to be important diagnostic biomarkers in autoimmune brain disease, including autoimmune encephalitis and autoimmune demyelination.<sup>1-3</sup> Myelin oligodendrocyte glycoprotein (MOG) is a minor component of myelin proteins but has been the focus of extensive research in demyelinating diseases. MOG is localized on the outermost surface of myelin and has a proposed role in the regulation

\*These authors contributed equally to this manuscript.  
 From the Neuroimmunology Group (R.C.D., E.M.T., V.M., R.Y.A., N.S., K. Pathmanandavel, S.R., F.B.), Institute for Neuroscience and Mental Health (R.C.D., E.M.T., V.M., R.Y.A., N.S., K. Pathmanandavel, S.R., F.B.), Institute for Neuroscience and Mental Health, Australia, Institute for Neuroscience and Allergy Research (D.R.B.), Westmead Millennium Institute for Medical Research, University of Sydney, Westmead, Australia, Clinical Neurology (L.A.W.), Royal Prince Alfred Hospital, Sydney Medical School, University of Sydney, Westmead, Australia, Department of Paediatrics (R. Clark), The Children's Hospital at Westmead, Australia, Department of Paediatric Neurology (D.R.C.), Women's and Children's Hospital, North Adelaide, Australia, Neuroimmunology Group (G.J.G., C.K.L.), MNTI and Neuroimmunology Research Centre, Monash University, Australia, School of Advanced Medicine, North Ryde, Australia, and Neuroimmunology Group (E.K.L.), Brain and Mind Research Institute, University of Sydney, Queensland, Australia.  
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## Student spotlight

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### Ben Russell, Bachelor of Medical Science (Hons)

Ben Russell graduated in 2016 with a Bachelor of Medical Science (Hons), after completing his final honours project at Brain and Mind Centre. His project, titled: 'Novel sources of tumour-derived biomarkers: neurosurgical CUSA aspirates as an enriched source of exosomal biomarkers' won the University Medal for its high marks and outstanding quality.

"My project involved analysing brain tumour material to potentially develop new biomarkers to aid in diagnosis and monitoring of tumour behaviour," says Ben. "I was able to identify specific molecules found in more lethal tumours, compared to less aggressive ones."

Ben's project was supervised by Dr Kim Kaufman, Head of NeuroOncology Biomarker Discovery and Translational Research, and Associate Professor Michael Buckland, Head of the Molecular Neuropathology Program at Brain and Mind Centre and Head of the Department of Neuropathology at Royal Prince Alfred Hospital.

"Both Michael and Kim were amazing supervisors," says Ben. "Through Michael we had the ability to go straight to the hospital and change protocols to help collect samples. Kim had all the expertise and know-how when it came to processing and analysing them. If either were just one step further removed, this project wouldn't have been possible. I think this really validates a lot of what gets said about places like Brain and Mind Centre – the integration of clinical services and research is such an invaluable relationship."



Ben Russell, University Medal recipient.

### Ben Russell Bachelor of Medical Science (Hons)

"I think this really validates a lot of what gets said about places like the Brain and Mind Centre - the integration of clinical services and research is such an invaluable relationship."

# ForeFront Ageing and Neurodegeneration

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At the forefront of research into  
ageing and neurodegeneration.

# ForeFront Ageing and Neurodegeneration

## Our core business

The ForeFront Ageing and Neurodegeneration team is committed to discovering early detection methods, identifying new treatments and understanding the underlying mechanisms of neurodegenerative disease.

Neurodegenerative diseases are becoming increasingly prevalent in our ageing population. They have a devastating impact on those affected and their families and place a huge economic and social impact on our society. Our research groups work together to help reduce this impact by improving the services offered to those affected, enhancing support for carers and offering new hope through clinical trials and the development of novel treatments.

Our research covers most neurodegenerative disorders, including frontotemporal dementia, motor neurone disease, Parkinson's disease, dementia with Lewy bodies, and Alzheimer's disease, as well as healthy brain ageing.

Our long-term research aims are to be able to improve and expedite diagnosis and to better understand how neurodegenerative processes work so that we can treat and potentially halt these debilitating diseases.

Our collaborative research program incorporates several research groups and laboratories, all focused on different but interrelated aspects of ageing and neurodegeneration.



## The Forefront team

### **ForeFront Dementia and Movement Disorders Laboratory, led by Professor Glenda Halliday**

Our laboratory studies the origin and development of neurodegenerative dementias and movement disorders. Our focus is on how neurodegeneration manifests when symptoms first show and how this relates to genetic makeup, changes identified in the brain, and blood markers of different pathologies. The aim is to identify and validate biomarkers that could be used in the diagnosis of neurodegenerative diseases and/or for monitoring responses to new classes of drugs for these debilitating disorders.

### **ForeFront Neurogenetics and Epigenetics Research Group, led by Associate Professor Jonathon Kwok**

Our group studies the relationship between genetic changes and features of dementia and related disorders. We also examine lifestyle and epigenetic factors in these diseases. Our research studies genetic variants in specific genes that have been implicated in sporadic and heritable forms of dementia and other neurodegenerative diseases. We focus on understanding how genetic mutations cause or increase the risk of disease to work towards better treatment strategies.

### **ForeFront Genetics of Parkinson's Disease Research Group, led by Professor Carolyn Sue**

Our research aims to improve diagnostic methods and genetic testing for patients with Parkinson's disease and other inherited forms of movement disorders. By identifying causative genes involved in these disorders, we are able to create patient-derived cell models with biologically relevant levels of abnormal proteins to further understand pathogenic mechanisms of disease. Our experiments have led to the discovery of novel disease pathways and new treatment approaches.

### **ForeFront Neurodegeneration Research Laboratory, led by Associate Professor Kay Double**

Our research is focused on understanding the cause and neurodegenerative processes in Parkinson's disease and other movement disorders so that we can better treat and ultimately prevent these conditions. Our laboratory-based research focuses on understanding how degenerative disorders, such as Parkinson's disease, dementia with Lewy bodies and motor neurone disease, damages brain and nerve cells. We are also researching how we can achieve a slower disease progression and better quality of life for patients. We work to develop better and earlier diagnostic tools and targeted treatment strategies for Parkinson's disease.

### **ForeFront Clinical Parkinson's Disease and Dementia with Lewy Bodies Research Group, led by Professor Simon Lewis**

Our research is dedicated to improving the quality of life for people with Parkinson's disease, dementia with Lewy bodies and related disorders and ultimately, to finding a cure for these diseases. By working with people affected by parkinsonism, we aim to find ways to predict the disease and to stem its progression. We work closely with other researchers who focus on brain conditions related to Parkinson's disease. We also collaborate with NeuroSleep, the Centre for Translational Sleep and Circadian Neurobiology, which seeks to better understand the relationship between sleep and a healthy brain.



**ForeFront Motor Neurone Disease Research Group, led by Professor Matthew Kiernan**

We are a multidisciplinary team focused on clinical neurology. We work to understand the mechanisms behind neurodegenerative diseases, develop novel diagnostic tools and trial new treatment strategies. We are currently investigating mechanisms, biomarkers and possible prevention strategies for neurodegeneration in motor neurone disease, frontotemporal dementia, chemotherapy-induced neurotoxicity, stroke, Machado-Joseph disease, spinal muscular atrophy and other inherited neuropathies. We also conduct clinical trials to investigate potential treatments for motor neurone disease, chronic inflammatory demyelinating polyneuropathy and other disorders.

**Frontier Frontotemporal Dementia Research Group, led by Professor John Hodges and Associate Professor Olivier Piguet**

Frontotemporal dementia is the second most common degenerative disease that causes dementia in younger adults. Our research group is dedicated to identifying better ways to diagnose frontotemporal dementia, finding the cause and developing effective treatments for the condition. Our multidisciplinary research examines the neurological, psychological and biological brain function in frontotemporal dementia, as well as how the disease impacts on the lives of patients and their families.

**ForeFront Healthy Brain Ageing Program, led by Professor Sharon Naismith**

We aim to determine whether changes in vascular risk factors, mood, sleep and lifestyle can effectively reduce cognitive decline, symptoms of depression and dementia-related brain changes in later life. Our research targets modifiable risk factors by providing early identification, intervention and prevention programs for people at risk for dementia. We evaluate clinical interventions including brain training programs, group-based psychoeducation programs to improve sleep disturbance, home-based exercise programs for people with early-stage dementia, and the development of internet-based tools to improve health and wellbeing, reduce depression and minimise vascular risk factors in older adults.



Patient at the Healthy Brain Ageing Clinic with Professor Sharon Naismith (right).

# ForeFront Ageing and Neurodegeneration Highlights

## Welcoming a world-leading team

In 2016 Professors Glenda Halliday, John Hodges and Associate Professor Olivier Piguet joined the Brain and Mind Centre, along with their significant team of researchers.

As long-term collaborators, joining forces with our pre-existing translational research teams at the Brain and Mind Centre has provided significant opportunities for advancing research into these highly debilitating disorders.

We welcome their internationally-renowned program of research, focused on developing treatments for dementia and other neurodegenerative diseases.



Professor Glenda Halliday.



Professor John Hodges.



Associate Professor Olivier Piguet.

## NHMRC Fellowship success

The ForeFront Ageing and Neurodegeneration team was highly successful in the 2015 NHMRC-ARC Dementia Research Development Fellowships. Eleven outstanding researchers in our team were awarded fellowships.

These were:

- **Dr Camillo Hoyos:** sleep-wake disturbances and cardio-metabolic dysfunction in at-risk dementia: a novel pathway in neurocognitive decline.
- **Dr Shantel Duffy:** neuroimaging insights into sleep-wake dysfunction in older adults at risk of developing dementia.
- **Dr Angela D’Rozario:** sleep, plasticity and neurodegeneration: targeting sleep to improve cognition in mild cognitive impairment (MCI).
- **Dr Loren Mowszowski:** cognitive interventions for older adults at risk of dementia and with early-stage neurodegenerative disease.
- **Dr Sharpley Hsieh:** cognition in motion: characterisation and evolution of cognitive dysfunction in motor neurodegeneration and frontotemporal dementia.
- **Dr Fiona Kumfor:** identifying novel markers to differentiate frontotemporal dementia from Alzheimer’s disease.

- **Dr Cristian Leyton-Moscoso:** disentangling aphasic syndromes in Alzheimer’s disease.
- **Dr Sivaraman Purushothuman:** Lewy bodies in patients with dementia – determining common and unique mechanisms in relation to Alzheimer’s disease.
- **Dr Surabhi Bhatia:** role of apolipoprotein D in Alzheimer’s disease and frontotemporal dementia.
- **Professor Simon Lewis:** predicting dementia and Parkinson’s disease in the clinic.
- **Dr Rachel Tan:** dual and multiple proteinopathies in neurodegenerative dementias – risk factors, prognostic indicators and clinical ramifications.

Dr Rebekah Ahmed received an NHMRC Early-Career Fellowship in 2016, titled *Characterisation of Eating Behaviour and Metabolic Phenotypes Across Neurodegenerative Diseases; Insights for Survival and Progression*.

## Funding for frontotemporal dementia

In 2016, Professor Glenda Halliday led a successful \$17 million NHMRC Program Grant titled *Frontotemporal Dementia and Motor Neurodegenerative Syndromes*. Frontotemporal degeneration of the brain is a leading cause of morbidity due to a pathologically heterogeneous, rapidly-progressing group of disorders with behavioural, language and motor deficits.

With this program grant, Professor Halliday’s internationally recognised team will continue to develop the necessary tools and therapies to effectively diagnose, manage and treat these disorders, with a particular focus on understanding the unusual genetics underpinning them and fast-tracking any potential treatments.

## Woolcock NeuroSleep Clinic

The Woolcock Neurosleep Clinic was established at Brain and Mind Centre in 2016 to advance collaborative research in translational sleep and circadian neurobiology. NeuroSleep is focused on improving cognition, workplace safety and health outcomes in patients with sleep concerns including shift workers, patients with sleep disorders, neurodegenerative diseases, and/or mental health problems.

The establishment of the Neurosleep Clinic was the result of our collaborations with the Woolcock Institute and a \$2.5 million NHMRC Centre of Research Excellence grant in 2014 for NeuroSleep: Centre for Translational Sleep and Circadian Neurobiology.

## Awards and promotions

The following team members received awards in recognition of research excellence in 2016:

- **Professor Simon Lewis:** in recognition of his cutting-edge research and excellence in teaching, Simon was promoted to Professor of Cognitive Neurology at Sydney Medical School, University of Sydney.
- **Professor Matthew Kiernan:** Matthew was awarded the M.J. Eadie Award for Career Achievement in Neuroscience.
- **Dr Rebekah Ahmed:** Rebekah was awarded the James Lance Young Investigator Award from the Australian and New Zealand Association of Neurology and the Susie Harris Travelling Fellowship from the Motor Neurone Disease Research Institute of Australia.
- **Professor Carolyn Sue:** Carolyn was awarded the Australian Mitochondrial Disease Foundation Community Award, as head of ForeFront Genetics of Parkinson's Disease Research Group.
- **Dr Brianada Koentjoro:** **Brianada** was awarded the Presidential Award by the International Movement Disorder Society in Berlin, for his research on Parkinson's disease, as part of ForeFront Genetics of Parkinson's Disease Research Group.
- **Benjamin Trist:** a PhD student from the Neurodegeneration Research Laboratory, Benjamin was named as Parkinson's New South Wales Young Researcher of the Year, for his work on a new protein abnormality in the Parkinson's disease brain.

## Community and industry appointments

In 2016, Professor Matthew Kiernan was elected President of the Australian and New Zealand Association of Neurologists (ANZAN).

Associate Professor Kay Double was re-elected to the position of Executive Secretary of the Australasian Neuroscience Society in 2016, the peak professional body for neuroscience research in Australia and New Zealand. She was also elected Chair of the Parkinson's New South Wales Advisory Group, a group of researchers and clinicians who provide expert advice on Parkinson's disease to Parkinson's New South Wales.

Professor Carolyn Sue became the only Australian to join the Wellcome Trust Centres of Excellence Review Panel in the United Kingdom, a philanthropic body providing funding to 14,000 scientists worldwide.

## Education

For the past two years, Professor Simon Lewis has delivered a highly successful teaching course, titled *Masterclass: Diseases of the Ageing Brain*. The course provides training to geriatricians, general practitioners, physicians, allied health workers, nurses and other healthcare providers in Australia and overseas, on the practical clinical aspects of common diseases affecting the ageing brain, including:

- Alzheimer's disease
- Lewy body dementia
- Parkinson's disease
- stroke.



CoreFront: Ageing and Neurodegeneration

## Research grants awarded

Members of our team received the following research grants:

### A selective prevention trial using novel pharmacotherapies in an older age cohort at risk for depression

**Led by:** Naismith, S.L., Christensen, H. and Hickie, I.B.

**Granting body:** NHMRC Project Grant

**Years:** 2014–16\*

**Amount:** \$947,670 (2014: \$416,068; 2015: \$411,068, 2016: \$120,534)

\*extended to 2017

### Modifying the trajectory of insidious late life cognitive decline using computerised cognitive training

**Led by:** Valenzuela, M. and Naismith, S.L.

**Granting body:** NHMRC Project Grant

**Years:** 2015–18

**Amount:** \$715,764 (2015: \$196,441, 2016: \$186,441, 2017: \$176,441, 2018: \$156,441)

### Brain oxidative stress and cognitive function in older adults with diabetes and pre-diabetes who are ‘at risk’ of dementia

**Led by:** Hoyos, C., Naismith, S.L., Colagiuri, S. and Duffy S.

**Granting body:** Diabetes Australia

**Year:** 2017

**Amount:** \$59,902

### NeuroSleep: the Centre for Translational Sleep and Circadian Neurobiology

**Led by:** Grunstein, R., Rajaratnam, S.W., Naismith, S.L., Eckert, D., Lewis, S.J.G., Glozier, N., Cistulli, P., Wong, K., Marshall, N. and Robinson, P.

**Granting body:** NHMRC Centre of Research Excellence

**Years:** 2014–18

**Amount:** \$2,496,739

### ARTFUL: a program for people living with dementia

**Led by:** Museum of Contemporary Art (Filopevic, Y.), Naismith, S.L. and Alzheimer’s Australia.

**Granting body:** Vincent Fairfax Family Foundation

**Years:** 2015–17

**Amount:** \$220,000

### PRT MEDIC: Progressive Resistance Training for Metabolic Syndrome and Depression Integrated Care: a randomised controlled trial

**Led by:** Mavros, Y., Fiatarone Singh, M., Naismith, S.L., Caterson, I. and Celermajer, D.

**Granting body:** Diabetes Australia

**Year:** 2017

**Amount:** \$59,837

**Investigating the utility of oxidative stress as a biomarker for cognitive decline and dementia: a longitudinal magnetic resonance imaging study in 'at risk' older adults and Alzheimer's disease**

**Led by:** Duffy, S. and Naismith, S.L.  
**Granting body:** Mason Foundation National Medical Program  
**Year:** 2016  
**Amount:** \$59,672.55

**HOMEeCare: caring for the dementia caregiver and their loved one via the HOMEeCare exercise and mindfulness for health program**

**Led by:** Fiatarone Singh, M.A., Naismith, S.L., Simic, M. and Mavros Y.  
**Granting body:** Dementia Collaborative Research Centres  
**Year:** 2016  
**Amount:** \$99,856.09

**Assessing sleep-wake cycles in paediatric traumatic brain injury using actigraphy**

**Led by:** Lah, S. and Naismith, S.L.  
**Granting body:** School of Psychology Research Infrastructure Block Grant, University of Sydney  
**Year:** 2016  
**Amount:** \$10,845

**Evaluation of a 12-week combined psychoeducation and home-based exercise program on mood and wellbeing in older adults with early Alzheimer's disease**

**Led by:** Duffy, S., Naismith, S.L., Jeon, Y-H. and Clemson L.  
**Granting body:** Alzheimer's Australia Dementia Research Funds  
**Year:** 2015  
**Amount:** \$50,000

**A therapeutic intervention in Alzheimer's disease intranasal oxytocin administration to enhance emotion processing and reduce caregiver burden**

**Led by:** McCade, D., Naismith, S.L. and Guastella, A.  
**Granting body:** Alzheimer's Australia Dementia Research Funds  
**Year:** 2015  
**Amount:** \$50,000

**Does the use of intranasal oxytocin improve emotional functioning and reduce carer burden in Alzheimer's disease?**

**Led by:** Naismith, S.L., McCade, D. and Guastella, A.  
**Granting body:** ANZ Trustees Mason Foundation  
**Year:** 2015  
**Amount:** \$59,300

**Utilising novel biomarkers to develop predictors of neurodegeneration**

**Led by:** Halliday, G.M., Grunstein, R.R., Naismith, S.L., Hodges, J.R., Piguat, O., D'Rozario, A. and Wang, Z.  
**Granting body:** Sydney Research Excellence Initiative (SREI)  
**Year:** 2017-2019  
**Amount:** \$150,000

**A randomised controlled trial of an enriched environment intervention to improve sleep and cognitive outcomes in older adults at risk from dementia**

**Led by:** Anderson, C., Naismith, S.L., Rajaratnam, S.W. and Cain, S.W.  
**Granting body:** The Mason Foundation  
**Years:** 2015  
**Amount:** \$35,000

# ForeFront Ageing and Neurodegeneration 2017 and beyond

We are committed to the early detection of and developing treatments for neurodegenerative diseases to understand their underlying disease mechanisms. Our goal for 2017 is to work cohesively in our new home at Brain and Mind Centre, in order to establish new clinics for people with neurodegenerative diseases, conduct new trials of potential therapies, discover new ways of measuring the success of these trials and to continue work on determining disease mechanisms to target in future treatments.



Professor Simon Lewis working with his patient.



# ForeFront Ageing and Neurodegeneration

## Key projects and clinical trials

### Key research projects

#### Nodal function in peripheral neuroinflammatory disorders target antigens, functional significance and treatment response.

**Collaborators:** Professor Matthew Kiernan, Dr Nidhi Garg, Dr Susanna Park, Professor John Pollard, Dr Emily Mathey and Professor Steve Vucic

**Funding body:** National Health and Medical Research Council (NHMRC)

#### Project MinE

**Collaborators:** Professor Leonard van den Berg and Professor Matthew Kiernan

**Funding bodies:** Motor Neurone Disease Research Institute of Australia, ALS Centrum Nederland and ALS Nederland

#### The Lighthouse Project

**Collaborators:** Professor Matthew Kiernan, Professor Julian Gold, Professor Dominic Rowe, Professor Steve Vucic, Dr Susan Mathers and Professor Paul Talman

**Funding body:** Cure for MND Foundation and Australian MND Association Research Institute of Australia (MNDRIA)

#### A new pathology in the Parkinson's disease brain

**Collaborators:** Brain and Mind Centre, University of Bordeaux (France), King's College London (United Kingdom), Neuroscience Research Australia (Sydney) and University of Technology Sydney (UTS)

**Funding body:** Parkinson's NSW

#### Defining Lewy Body dementia

This research resulted in the publication of new diagnostic criteria for the diagnosis and management of dementia with Lewy bodies, published in highly cited journal *Neurology*. It was also the fourth consensus report of the Dementia with Lewy Body Diagnosis consortium.

**Collaborators:** Dementia with Lewy Body Diagnosis Consortium (including Professor Glenda Halliday)

#### Validation of the Movement Disorders Society Parkinson's disease diagnostic criteria

Brain and Mind Centre was the only site in the southern hemisphere to take part in the validation of the newly proposed diagnostic criteria for Parkinson's disease.

**Collaborators:** Ron Postuma (Montreal) and Daniela Berg (Kiel)  
**Funding body:** Michael J Fox Foundation and the International Movement Disorders Society

### Clinical trials

#### A randomised, cross-over study to evaluate efficacy and tolerability of FLX-787 in patients with motor neurone disease

This clinical trial is investigating spasticity and cramps in patients with motor neurone disease.

**Collaborators:** Professor Matthew Kiernan, Dr Susan Mathers, Dr Robert Henderson, Neuroscience Trials Australia and Thomas Wessel, Flex-Pharma  
**Funding body:** Flex-pharma



# ForeFront Ageing and Neurodegeneration

## Key publications

### The ForeFront Motor Neurone Disease Research Group

1. Menon, P., Geevasinga, N., Yiannikas, C., Howells, J., Kiernan, M.C. and Vucic, S. (2015). Sensitivity and specificity of threshold tracking transcranial magnetic stimulation for diagnosis of amyotrophic lateral sclerosis: a prospective study. *Lancet Neurology*, May; 14(5):478-84.
2. Farrar, M.A., Park, S.B., Vucic, S., Carey, K.A., Turner, B.J., Gillingwater, T.H., Swoboda, K.J. and Kiernan, M.C. (2016). Emerging therapies and challenges in spinal muscular atrophy. *Annals of Neurology*, Dec 27. doi: 10.1002/ana.24864.
3. Garg, N., Park, S.B., Vucic, S., Yiannikas, C., Spies, J., Howells, J., Huynh, W., Matamala, J.M., Krishnan, A.V., Pollard, J.D., Cornblath, D.R., Reilly, M.M. and Kiernan, M.C. (2016). Differentiating lower motor neurone syndromes. *Journal of Neurology, Neurosurgery, and Psychiatry*, Dec 21. pii: jnnp-2016-313526. doi: 10.1136/jnnp-2016-313526.
4. Ahmed, R.M., Irish, M., Piguet, O., Halliday, G.M., Ittner, L.M., Farooqi, S., Hodges, J.R. and Kiernan, M.C. (2016). Amyotrophic lateral sclerosis and frontotemporal dementia: distinct and overlapping changes in eating behaviour and metabolism. *Lancet Neurology*, Vol 15, pp 332-342.
5. Van Rheenen, W., Shatunov, A., Dekker, A.M., et al. PARALS Registry; SLALOM Group; SLAP Registry; FALS Sequencing Consortium; SLAGEN Consortium; NNIPPS Study Group, Blair, I., Zhang, K., McCann, E.P., Fifita, J.A., Nicholson, G.A., Rowe, D.B., Pamphlett, R., Kiernan, M.C., Grosskreutz, J., Witte, O.W., Ringer, T., Prell, T., Stubendorff, B., Kurth, I., Hübner, C.A., Leigh, P.N., Casale, F., Chio, A., Beghi, E., Pupillo, E., Tortelli, R., Logroscino, G., Powell, J., Ludolph, A.C., Weishaupt, J.H., Robberecht, W., Van Damme, P., Franke, L., Pers, T.H., Brown, R.H., Glass, J.D., Landers, J.E., Hardiman, O., Andersen, P.M., Corcia, P., Vourch, P., Silani, V., Wray, N.R., Visscher, P.M., de Bakker, P.I., van Es, M.A., Pasterkamp, R.J., Lewis, C.M., Breen, G., Al-Chalabi, A., van den Berg, L.H. and Veldink, J.H. (2016). Genome-wide association analyses identify new risk variants and the genetic architecture of amyotrophic lateral sclerosis. *Nat Genet*, doi: 10.1038/ng.3622.
6. Park, S.B., Vucic, S., Cheah, B.C., Lin, C.S., Kirby, A., Mann, K.P., Zoing, M.C., Winhammar, J. and Kiernan, M.C. (2016). Flecainide in Amyotrophic Lateral Sclerosis as a Neuroprotective Strategy (FANS): a randomized placebo-controlled trial. *EBioMedicine*, 2015; 2(12):1916-22.
7. Shibuya, K., Park, S.B., Geevasinga, N., Menon, P., Howells, J., Simon, N.G., Huynh, W., Noto, Y., Götz, J., Kril, J.J., Ittner, L.M., Hodges, J., Halliday, G., Vucic, S. and Kiernan, M.C. (2016). Motor cortical function determines prognosis in sporadic ALS. *Neurology*, 2; 87(5):513-20.
8. Hogden, A., Greenfield, D., Nugus, P. and Kiernan, M.C. (2015). Development of a model to guide decision making in multidisciplinary care. *Health Expectations*, 18:1769-82.



Associate Professor Kay Double.

### The Neurodegeneration Research Laboratory

1. Davies, K., Hare, D., Bohic, S., James, S., Billings, J., Finkelstein, D., Doble, P. and Double, K.L. (2015). A comparative study of metal quantification in neurological tissue using laser ablation-inductively coupled plasma-mass spectrometry imaging and x-ray fluorescence microscopy. *Analytical Chemistry*, 87, 6639-45.
2. Davies, K.M., Julian F.B., Mercer, J.F.B., Chen, N. and Double, K.L. (2016). Copper dyshomeostasis in Parkinson's disease: implications for pathogenesis and indications for novel therapeutics. *Clinical Science*, 130, 565-574.
3. Hare, D.J. and Double, K.L. (2016). Iron and dopamine: a toxic couple. *Brain*, Apr; 139(Pt 4):1026-35.

### The Clinical Parkinson's Disease and Dementia with Lewy Bodies Research Group

1. Muller, A.J., O'Callaghan, C., Walton, C.C., Shine, J.M. and Lewis, S.J.G. Retrospective neuropsychological profile of Parkinson's disease patients prior to developing visual hallucinations. *J Ger Psych Neur*, (accepted October 2016).
2. O'Callaghan, C., Hornberger, M., Balsters, J.H., Halliday, G.M., Lewis, S.J.G. and Shine, J.M. (2016). Cerebellar atrophy in Parkinson's disease and its implication for network connectivity. *Brain*, 139:845-55.
3. Trenkwalder, C., Chaudhuri, K.R., García Ruiz, P.J., LeWitt, P., Katzenschlager, R., Sixel-Döring, F., Henriksen, T., Sesar, Á., Poewe, W., Baker, M., Ceballos-Baumann, A., Deuschl, G., Drapier, S., Ebersbach, G., Evans, A., Fernandez, H., Isaacson, S., van Laar, T., Lees, A., Lewis, S.J.G., Martínez Castrillo, J.C., Martínez-Martin, P., Odin, P., O'Sullivan, J., Tagaris, G. and Wenzel, K. (2015). Expert Consensus Group report on the use of apomorphine in the treatment of Parkinson's disease – clinical practice recommendations. *Parkinsonism Relat Disord*, 21:1023-30.
4. Gilat, M., Shine, J.M., Walton, C.C., O'Callaghan, C., Hall, J. and Lewis, S.J.G. Brain activation underlying turning in Parkinson's disease patients with and without Freezing of Gait: a virtual reality fMRI study. *npj Parkinson's Disease*, (accepted August 2015).
5. Szeto, J.Y., O'Callaghan, C., Shine, J.M., Mowszowski, L., Walton, C.C., Naismith, S.L., Halliday, G.M. and Lewis, S.J.G. The relationships between mild cognitive impairment and phenotype in Parkinson's disease. *npj Parkinson's Disease*, (accepted July 2015).
6. Shine, J.M., Muller, A.M., Hornberger, M., O'Callaghan, C., Halliday, G.M. and Lewis, S.J.G. (2015). Abnormal connectivity between the default mode and the visual system underlies the manifestation of visual hallucinations in Parkinson's disease: a task-based fMRI study. *npj Parkinson's Disease*, doi 10.1038/npjparkd.2015.3.

### The Healthy Brain Ageing Program

1. McKinnon, A., Lagopoulos, J., Terpening, Z., Grunstein, R., Hickie, I., Batchelor, J., Lewis, S., Duffy, S., Shine, J. and Naismith, S. (2016). Sleep disturbance in mild cognitive impairment is associated with alterations in the brain's default mode network. *Behavioral Neuroscience*, 130(3), 305–315.
2. Mowszowski, L., Lampit, A., Walton, C. and Naismith, S. (2016). Strategy-based cognitive training for improving executive functions in older adults: a systematic review. *Neuropsychology Review*, 26(3), 252–270.
3. Terpening, Z., Lewis, S., Yee, B., Grunstein, R., Hickie, I. and Naismith, S. (2015). Association between sleep-disordered breathing and neuropsychological performance in older adults with mild cognitive impairment. *Journal of Alzheimer's Disease*, 46(1), 157–165.
4. Duffy, S.L., Lagopoulos, J., Terpening, Z., Hickie, I.B. and Naismith, S.L. (2016). Association of anterior cingulate glutathione with sleep apnea in older adults 'at-risk' for dementia. *Sleep*, 39(4): 899–906.
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# The Lambert Initiative for Cannabinoid Therapeutics

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Alleviating human suffering  
with medicinal cannabis.

# The Lambert Initiative for Cannabinoid Therapeutics

## Our core business

The Lambert Initiative for Cannabinoid Therapeutics was founded in 2015, thanks to an unprecedented pledge of \$33.7 million to the University by Barry and Joy Lambert – the largest single gift in the history of the University of Sydney. The Lambert Initiative, based at Brain and Mind Centre, is a long-term research program exploring the medicinal potential of the cannabis plant.

Our vision is to conduct the high quality research required to discover, develop and optimise safe and effective cannabinoid therapeutics in Australia and beyond.

The Lambert Initiative provides national and international leadership in the science of medicinal cannabinoids and in the discovery and development of cannabis-based medicines. Our activities span a wide spectrum of basic science and clinical activities, from plant science, cellular and preclinical pharmacology, to medicinal chemistry and drug discovery, with the ultimate goal of producing cannabinoid-based medicines and ensuring their availability to patients.

### Advocacy and education

In parallel with our scientific endeavours, the Lambert Initiative also acts in an advocacy and educational capacity, providing synthesis of evidence and guidance for clinicians, targeting consumers, health professionals and politicians and influencing regulatory approaches and public health policy.

For many patients and families, the future of medicinal cannabis is one of hope: hope that legislation will change to make medical cannabis and future cannabinoid drugs more accessible. Hope that attitudes change to encourage practitioners to prescribe medicinal cannabis. A key aspect of the Lambert Initiative's vision is to provide tangible scientific evidence to help translate hope into reality.

# The Lambert Initiative for Cannabinoid Therapeutics Highlights



Dr Michael Bowen (right) with University of Sydney Dean of Science, Professor Trevor Hambley.

In our first year of operation, we established a state-of-the-art research facility at Brain and Mind Centre and have recruited quality national and international researchers to the team.

In addition, we have:

- established multidisciplinary collaboration to support our research
- established a supply of purified cannabinoids from industrial hemp and organic syntheses
- discovered novel therapeutic indications for some cannabinoids and novel modes of action
- made important translational discoveries that deepen our understanding of the efficacy of cannabinoid therapeutics
- used scientific expertise and evidence to influence the regulatory landscape.

## The PELICAN study

The PELICAN study, launched in July 2015, gives a voice to families living with epilepsy, to share their experiences of wanting to use cannabis to treat seizures. The study involves interviews with parents and the collection and chemical analysis of oils and extracts already being used in the community, to link the cannabinoid content to its therapeutic effects. Parents have the option of finding out the results of the analysis and are provided with education on the cannabis plant, its constituents, and current clinical safety data.

The PELICAN study has the potential to provide better understanding of the cannabinoid components that provide these therapeutic effects, which may lead to novel medications that could prove extremely effective.

## Survey into cannabis use for epilepsy management

Published in *Epilepsy & Behaviour*, the Epilepsy Action Australia study, in partnership with the Lambert Initiative, surveyed 976 respondents to examine cannabis use in people with epilepsy, their reasons for using cannabis and any perceived benefits self-reported by consumers (or their carers).

The survey revealed that 14 percent of people with epilepsy have used cannabis products as a way to manage seizures. The study also showed that of those with a history of cannabis product use, 90 percent of adults and 71 percent of parents of children with epilepsy reported success in managing seizures after using cannabis products.

Across all respondents, the main reasons for trying cannabis products were to manage treatment-resistant epilepsy and to reduce side effects compared to standard antiepileptic drugs. The number of past antiepileptic drugs used was a significant predictor of medicinal cannabis use in both adults and children with epilepsy.

## Medical cannabis trial for chemotherapy patients

A clinical trial using a new form of cannabis developed by our researchers is assessing the use of the drug to prevent nausea and vomiting in people undergoing chemotherapy.

The trial is part of the NSW Government's \$21 million commitment to support medicinal cannabis reforms. It will be coordinated at the NHMRC Clinical Trials Centre and aims to develop a better understanding of how cannabis products can provide relief to patients undergoing chemotherapy who have not had their symptoms controlled by standard treatments.

This trial represents a major advance for cannabis-based medications. It's an oral capsule of reliable doses of cannabinoids extracted from cannabis plants, under pharmaceutical grade conditions.

## Cannabinoid replacement drug trial to help cannabis smokers quit

This pioneering study builds on our team's previous work, which demonstrated that Sativex<sup>®</sup> suppressed cannabis withdrawal symptoms in an inpatient setting.

If the trial of Sativex<sup>®</sup> proves effective, it could be a promising breakthrough in the treatment of cannabis dependence, which affects one in ten users. Cannabis dependence can contribute to an array of health problems, including cognitive, psychiatric, cardiovascular and respiratory disorders.

Existing treatments for cannabis dependence have had only modest success. Current best practice counselling approaches, such as cognitive behavioural therapy (CBT), have a 70 to 80 percent relapse rate within six months. Treatments for acute cannabis withdrawal have similar relapse rates.

As with treatment of many other addictions, our team is keen to examine the effects of combining counselling with medication, an approach proven to be more effective than using either approach in isolation.

## Awards

Dr Michael Bowen from Brain and Mind Centre's Lambert Initiative, was awarded the Eureka Prize for Outstanding Early-Career Researcher on 1 September 2016. The prestigious Eureka Prize rewards excellence in the fields of scientific research and innovation, science leadership, school science, and science journalism and communication.

Dr Bowen's award recognised his work on discovering and developing novel treatments for serious brain disorders. He has established that oxytocin and novel molecules that target the brain's oxytocin system are effective treatments for alcohol-use disorders, substance-use disorders and social disorders.

Dr Bowen has demonstrated that exogenously administered oxytocin is able to powerfully inhibit alcohol consumption. He has also shown that oxytocin blocks alcohol's ability to act as key addiction pathways in the brain. He is currently involved in a phase II clinical trial to translate these effects on humans.

Dr Bowen is also one of the lead inventors of a series of small molecules that powerfully stimulate the brain oxytocin system, overcoming some of the limitations of administering oxytocin. Clinical trials to test one of these molecules in humans is underway.



Barry Lambert announces the donation to form the Lambert Initiative.

# The Lambert Initiative for Cannabinoid Therapeutics 2017 and beyond

## Cannabinoid researchers join forces

In May 2017, the University of Sydney and Thomas Jefferson University (TJU) in Philadelphia, USA agreed to collaborate on education and research on the therapeutic uses of cannabinoids. Both universities have dedicated centres, supported by the generous funding of the Lambert family, to conduct their work on medicinal cannabis.

This is an exciting opportunity for research collaboration to identify novel cannabis-derived treatments for epilepsy, pain and metabolic disorders.

The recent launch of the Lambert Center for the Study of Medicinal Cannabis and Hemp within the Institute for Emerging Health Professions adds to TJU's healthcare and medical research focus.

The two Lambert research centres will explore collaborations in:

- clinical trials of extracts of cannabis plants as adjuncts or alternatives to conventional prescription medications in treating and preventing disease
- academic exchange to facilitate the training of scientists and clinicians in the cannabinoid scientific space
- educational programs for physicians, other medical professionals and the public.



The Lambert Initiative research team left to right: Associate Professors Jonathon Arnold and David Allsop, Professor Iain McGregor, Dr Michael Bowen.

# The Lambert Initiative for Cannabinoid Therapeutics

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ACS Chemical Neuroscience

Research Article

Effects of Bioisosteric Fluorine in Synthetic Cannabinoid Designer Drugs JWH-018, AM-2201, UR-144, XLR-11, PB-22, 5F-PB-22, APICA, and STS-135

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Supporting Information

**ABSTRACT:** Synthetic cannabinoid (SC) designer drugs featuring bioisosteric fluorine substitution are identified by forensic chemists and toxicologists with increasing frequency. Although terminal fluorination of N-piperidyl indole SCs is sometimes known to improve cannabinoid type 1 (CB<sub>1</sub>) receptor binding affinity, little is known of the effects of fluorination on functional activity of SCs. This study explores the *in vitro* functional activities of SC designer drugs JWH-018, UR-144, PB-22, and APICA, and their respective terminally fluorinated analogues AM-2201, XLR-11, 5F-PB-22, and STS-135 at human CB<sub>1</sub> and CB<sub>2</sub> receptors using a FRET membrane potential assay. All compounds demonstrated agonist activity at CB<sub>1</sub> (EC<sub>50</sub> = 24–109 nM) and CB<sub>2</sub> (EC<sub>50</sub> = 6.5–200 nM) receptors, with the fluorinated analogues generally showing increased CB<sub>1</sub> receptor potency (~2–5 times). Additionally, the cannabinomimetic activities and relative potencies of JWH-018, AM-2201, UR-144, XLR-11, PB-22, 5F-PB-22, APICA, and STS-135 *in vivo* were evaluated in rats using biodometry. All SCs dose-dependently induced hypothermia and reduced heart rate at doses of 0.3–10 mg/kg. There was no consistent trend for increased potency of fluorinated SCs over the corresponding des-fluoro SCs *in vivo*. Based on magnitude and duration of hypothermia, the SCs were ranked for potency (PB-22 > 5F-PB-22 > JWH-018 > AM-2201 > APICA > STS-135 > XLR-11 > UR-144).

**KEYWORDS:** Cannabinoid, JWH-018, AM-2201, XLR-11, PB-22

Synthetic cannabinoids (SCs) are the most rapidly growing class of recreational “designer drugs.” The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) reports that, as of March 2015, 134 new SCs have been identified in the European Union (EU) since 2008, with 30 novel SCs formally notified in 2014 alone.<sup>1</sup> In the United States (US) in 2010, the Drug Enforcement Administration’s National Forensic Laboratory Information System (NFLIS) reported 19 distinct SCs across 1286 samples, but by 2012, there were 61 SC variants identified in 41 458 cases.<sup>2</sup> In the EU in 2013, there were over 21 000 seizures of SCs, a more than 200-fold increase since 2008.<sup>3</sup> Many SCs have no precedent in the scientific literature yet bear hallmarks of rational design. Like Δ<sup>9</sup>-tetrahydrocannabinol (Δ<sup>9</sup>-THC; 1, Figure 1), the principal bioactive component of cannabis, SCs typically exert agonist activity at both cannabinoid receptor subtypes, namely,

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Figure 1. Selected natural and synthetic cannabinoids.

CB<sub>1</sub> and CB<sub>2</sub> receptors, with psychomotor activation to activation of the former.<sup>4</sup> Generally, SCs are found in smoking mixtures of otherwise nonpsychoactive herbal blends and are intended to substitute for the intoxicating effects of Δ<sup>9</sup>-THC. Although these products are disingenuously marketed as “natural” and “legal” for human consumption,<sup>5</sup> consumers are aware of the psychoactivity of such products and use them as technically legal cannabis substitutes. One of the earliest SC products, branded “Spice”, was analyzed in 2008 and found to contain the CB<sub>1</sub> homologue of CP-47,497 (CP-47,497-CB<sub>1</sub>; 2) and an (aminoalkyl)indole analogue of WIN 55,212-3 (3) known as JWH-018 (4), thereby accounting for the anecdotal cannabinomimetic effects of this product.<sup>6</sup> After the active ingredients of Spice were identified, many governments prohibited CP-47,497-CB<sub>1</sub> and JWH-018, forcing manufacturers of Spice to circumvent restrictions by substituting the active constituents with other unregulated SCs. The iterative cycle of SC identification, prohibition, and substitution has produced hundreds of differently branded products, with names like “Kronic” and “K2”, containing one or more SCs. A popular design trend in the SC market currently is the incorporation of a terminal fluorine atom in variously substituted N-piperidylindoles.<sup>7</sup> The terminally fluorinated analogue of JWH-018, AM-2201 (5), was one of several

nano-molar affinity SCs (CB<sub>1</sub> K<sub>d</sub> = 10 nM; CB<sub>2</sub> K<sub>d</sub> < 2 nM) reported by Makrisinis and colleagues in 2001,<sup>8</sup> and was identified in consumer products by forensic researchers in several countries in 2011.<sup>9</sup> Anecdotal reports that AM-2201 possesses psychomotor activity at submilligram doses in humans likely instigated the trend of bioisosteric fluorine substitution in other structurally related SC designer drugs. For example, South Korea’s National Forensic Service reported no fluorinated SCs in 2010, but 90% of all seized SCs were fluorinated by 2013.<sup>10</sup> Several dozen terminally fluorinated SCs have been reported by forensic laboratories worldwide, and the rate of emergence appears to be increasing.<sup>11</sup>

The SC sold as UR-144 (7; CB<sub>1</sub> K<sub>d</sub> = 150 nM; CB<sub>2</sub> K<sub>d</sub> = 1.8 nM) was first reported by Abbott Laboratories in 2010 during their exploration of CB<sub>2</sub>-selective ligands<sup>12,13</sup> and has since been identified in numerous forensic samples.<sup>14–16</sup> The *cis*-fluoro analogue of UR-144, sold as XLR-11 (8), has also been identified in consumer products, despite no prior reports of its structure in the scientific literature.<sup>17–19</sup> In Korea, XLR-11 first appeared in 2012 and was the most frequently encountered SC by 2013.<sup>10</sup> XLR-11 use is associated with adverse health effects, including acute kidney injury (AKI)<sup>20,21</sup> and cerebral ischemia.<sup>22</sup> Wiley and colleagues recently showed that XLR-11 (CB<sub>1</sub> K<sub>d</sub> = 24 nM; CB<sub>2</sub> K<sub>d</sub> = 2.1 nM) has binding affinities

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# Technical Facilities

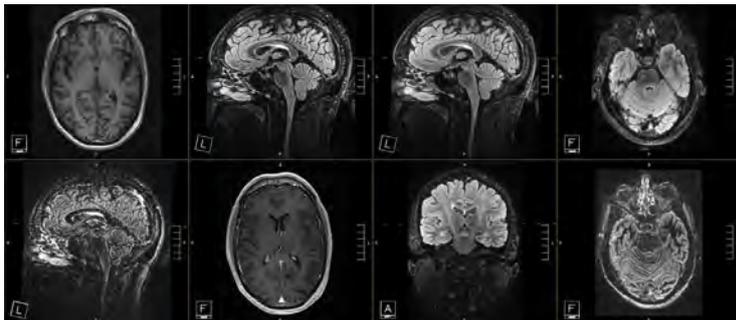
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State of the art research  
and clinical facilities.

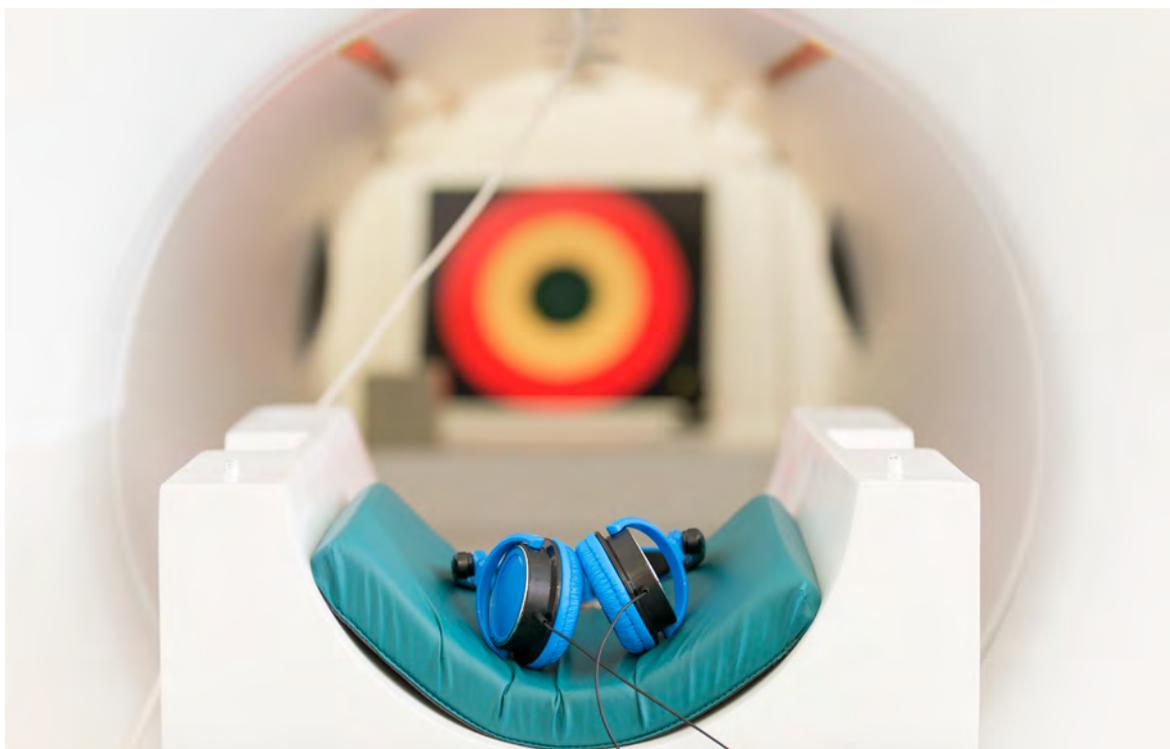
# Technical Facilities

## Our core business

Brain and Mind Centre fosters an environment that supports world leaders in mental health, neuroscience and neurology. Our researchers are supported by strong research capabilities, underpinned by a network of shared research facilities in imaging, neuropathology, microscopy and a neurology laboratory.



MRI research from Southern Radiology.



## Imaging

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Our state-of-the-art imaging facilities span preclinical and clinical imaging, as well as the Sydney Neuroimaging Analysis Centre.

### Preclinical imaging

Brain and Mind Centre is home to the University of Sydney and ANSTO Node of the Australian National Imaging Facility. This shared facility provides researchers with access to state-of-the-art imaging capabilities for research. The preclinical imaging platform includes micro-PET, PET-CT, PET/SPECT/CT and 3T MRI scanners as well as autoradiography, radio-metabolite analysis and tissue counting facilities.

Our imaging researchers are focused on developing new technologies for non-invasive imaging and imaging biomarker development. We collaborate with many researchers, both at Brain and Mind Centre and overseas, to develop new imaging methods and test new drugs and interventions for various brain disorders, including neurodegenerative diseases, mood disorders and cancer.

Our imaging scientists have an outstanding track record in preclinical imaging innovation, developing novel technologies for the advancement of neuroimaging research and understanding of disease processes.

### Clinical imaging

Southern Radiology is a leading provider of radiological services in Sydney, operating a network of radiology practices across the city, including an imaging research facility at Brain and Mind Centre. This facility houses a state-of-the-art 3 Tesla Magnetic Resonance Imaging (MRI) scanner, capable of running structural, diffusion, functional and spectroscopic imaging for research as well as for patient care.

Through our collaboration with Southern Radiology, Brain and Mind Centre researchers have developed a sophisticated multinuclear spectroscopy program that provides the ability to image a range of spectroscopic nuclei. The technique, known as magnetic resonance spectroscopy (MRS), is used to study the metabolic changes associated with diseases that affect the brain. It also provides additional information on top of the structural information that is obtained from MRI alone.

Our researchers are studying the changes that occur in the brain as a result of a particular disease, which may ultimately be helpful in the clinical diagnosis and treatment of these diseases.

### Sydney Neuroimaging Analysis Centre

Also housed at Brain and Mind Centre's Mallett Street campus is the Sydney Neuroimaging Analysis Centre, a cutting-edge facility that uniquely integrates in-house neuroimaging research with a dedicated, regulatory-compliant commercial image analysis facility for Phase 2, 3 and 4 clinical research trials.

## Neuropathology

Our extensive expertise in neuropathology allows us to analyse the molecular and cellular basis of neurological diseases, including brain tumours and neurodegenerative conditions.

In doing so, we can identify new ways of diagnosing these disorders when the disease first manifests, allowing patients to benefit from the most effective interventions available, as early as possible. By increasing our knowledge of the underlying basis of these diseases, we can help progress the development of new and more effective treatments.

We are working on developing novel blood tests that enable early detection of major diseases, including brain tumours and multiple sclerosis. We are also investigating brain tumour tissue to learn more about its complex genetic makeup and how brain tumours manipulate their surroundings in order to grow.

Our neuropathology research program is part of the Royal Prince Alfred Department of Neuropathology; the only neuropathology department in New South Wales that provides specialist diagnostic expertise, including:

- tissue-based diagnostic services for the Royal Prince Alfred Hospital
- a second opinion service for complex cases from across NSW and overseas
- molecular testing services for brain tumours
- NSW state referral laboratory for Creutzfeldt-Jacob Disease (CJD) diagnosis
- autopsy neuropathology
- muscle biopsy pathology.

## Microscopy

Brain and Mind Centre's microscopy facilities provide researchers with access to sophisticated technology to observe diseases of the brain and mind at a micro level.

The microscopy facility based at Brain and Mind Centre forms part of Sydney Microscopy and Microanalysis (SMM), the University of Sydney's largest core facility run by the Australian Centre for Microscopy and Microanalysis. This cross-disciplinary research centre is one of the most comprehensive microscopy centres in the world, with world-class instrumentation and technical expertise available for all researchers.

In early 2017, the microscopy core facility was rolled into the University's core facility: Sydney Microscopy and Microanalysis (SMM). This gives us access to a combined facility management booking system that allows users to seamlessly book any microscopy platform across Brain and Mind Centre, Madsen and the Charles Perkins Centre.

## Neurology Laboratory

Brain and Mind Centre's Neurology Laboratory is Australia's first specialised neuromuscular pathology unit. We are one of the world's leading centres for diagnosis and research into nerve and muscle diseases.

The Neurology Laboratory, a collaboration between the University of Sydney and Royal Prince Alfred Hospital, is a state reference laboratory for peripheral nerve and muscle histopathology (NATA/RCPA Accreditation Number 2146). Established in the late 1960s, the laboratory was the first specialised neuromuscular pathology unit in Australia. We remain one of the world's leading centres for diagnosis and research into diseases of nerve and muscle.

The laboratory holds one of the largest curated nerve archives in the world. This repository is an invaluable resource for research and teaching across brain and mind sciences. The laboratory has produced more than 300 original research publications and trained numerous PhD and other higher degree students.



# Technical Facilities

## Highlights

In December 2016 the microscopy team were awarded a research portfolio SHINE award from the University of Sydney, recognising their outstanding commitment to partnering with the research community as well as the wider University.

### Research grants awarded in 2017

**A system for simultaneous brain PET and behavioural measurements in freely moving mice**

**Led by:** Meikle, S.

**Granting body:** DVC Research/ Bridging Support Grant

**Years:** 2017

**Amount:** \$30,000

**Total-body PET technology and methods for biological systems research in metabolic disorders and mental illness**

**Led by:** Meikle, S.R. and Cherry, S.R.

**Granting body:** University of Sydney – University of California, Davis Priority Partnership Collaboration Awards Program 2017

**Years:** 2017

**Amount:** \$40,000

### Research grants awarded in 2016

**National Imaging Facility (NIF) UNSW Nodes**

**Led by:** Meikle, S.

**Granting body:** NSW Department of Industry/Research Attraction and Acceleration Program

**Years:** 2016–19

**Amount:** \$810,000

**A novel scintillating optical fibre array for cancer imaging and therapy**

**Led by:** Kuncic, Z., Vial, P., Atakaramians, S. and Meikle, S.

**Granting body:** Australian Research Council (ARC)/Linkage Projects (LP)

**Years:** 2015–18

**Amount:** \$288,170

**PET imaging of learning-related plasticity in awake behaving rats**

**Led by:** Balleine, B., Meikle, S. and Fulton, R.

**Granting body:** Australian Research Council (ARC)/ Discovery Projects (DP)

**Years:** 2016–20

**Amount:** \$995,000

## Imaging research

### Imaging brain behaviour

In 2015-16, our team used a new technique for the first time in the real world. This technique, which we have developed over the past 10 years, enabled us to undertake positron emission tomography (PET) brain imaging on animals while they were conscious and freely moving. This means we can study how the brain responds to its environment, what chemical changes take place during certain behaviours and how this affects disease.

In 2015-16, we collaborated with researchers at the University of New South Wales to use this new imaging technique to understand the role of dopamine in learning-related plasticity.

### Total-body PET technology and methods for biological systems research in metabolic disorders and mental illness

While PET can probe the metabolic and signalling pathways underlying chronic disease processes, the key questions in mental illness and diabetes cannot be addressed using single organ imaging. This proposal brings the research teams at the University of California, Davis and the University of Sydney together to develop completely new quantitative whole body PET imaging approaches to study chronic diseases.

**Collaborator:** Professor Simon Cherry, University of California, Davis.

**Funding body:** University of Sydney – University of California, Davis Priority Partnership Collaboration Awards Program.

## Neuropathology research

### A state-wide centre for forensic pathology

In June 2015, Brain and Mind Centre's neuropathology service became a state-wide forensic pathology service, making us the largest centre for brain autopsy examination in New South Wales.

This NSW Health recognition consolidates us as a national centre for expertise alongside NSW Health Pathology and Sydney Local Health District.

### Next generation sequencing

In 2016, we acquired a new deep sequencer (next generation sequencing technology) to diagnose and research diseases of the brain and mind. We can sequence 80 million strands of DNA at the same time. This means that we can research much more tailored drug therapies. For example, we can now profile a person's brain tumour to assess them for tailored drug targets and therefore provide patients with more treatment options.



Susannah Hallal, Dr Maggie Lee, Dr Kim Kaufman and Associate Professor Michael Buckland (left to right).

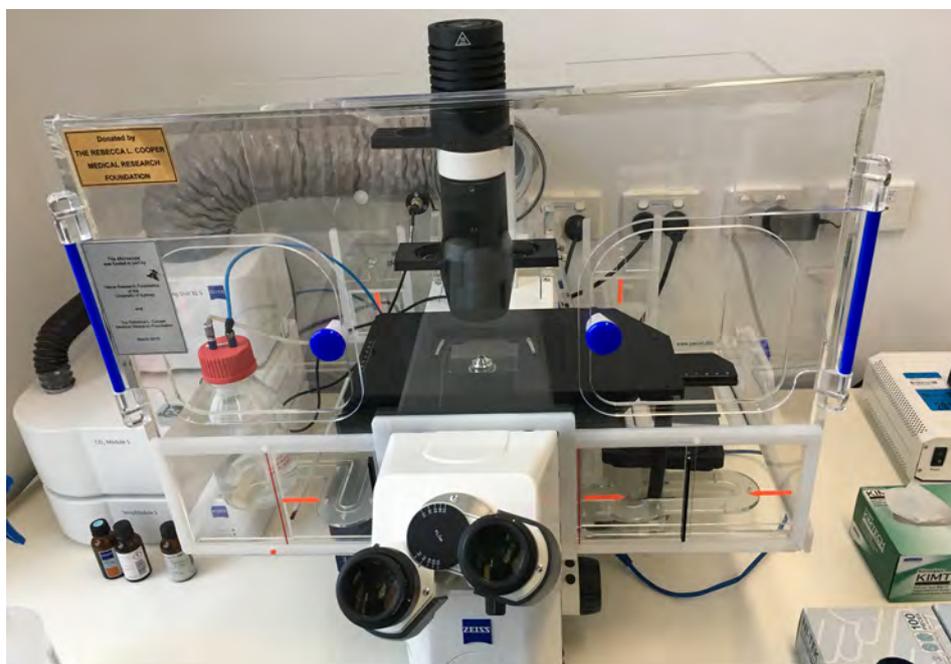
# Technical Facilities

## 2017 and beyond

### A centralised laboratory

A new centralised laboratory will allow microscopy equipment to be consolidated from across Brain and Mind Centre, to allow better service and guidance from the microscopy technicians.

The laboratory will house all the microscopy systems that are currently managed by SMM, as well as a newly acquired slide scanner, new analysis computers and new fluorescence microscopes. The facility will also be home to two new confocal systems, which were acquired as part of a NHMRC / University of Sydney grant by Professor Glenda Halliday. One of these systems is optimised for multiparameter fluorescence analysis of slides, while the other is configured for the time-lapse or real time observation of live cells and tissues in culture.



# Technical Facilities

## Key publications

1. Gillam, J., Angelis, G., Kyme, A. and Meikle, S. (2017). Motion compensation using origin ensembles in awake small animal positron emission tomography. *Physics in Medicine and Biology*, 62(3), 715-733.
2. Barnett, R., Meikle, S. and Fulton, R. (2016). Cross population motion modeling applied to attenuation correction of respiratory gated F18-FDG PET. *IEEE Transactions on Nuclear Science*, 63(1), 170-179.
3. Cochran, B., Ryder, W., Parmar, A., Tang, S., Reilhac, A., Arthur, A., Charil, A., Hamze, H., Barter, P., Kritharides, L., Meikle, S., Rye, K., et al. (2016). In vivo PET imaging with [18F]FDG to explain improved glucose uptake in an apolipoprotein A-I treated mouse model of diabetes. *Diabetologia*, 59(9), 1977-1984.
4. Gillam, J., Angelis, G. and Meikle, S. (2016). List-mode image reconstruction for positron emission tomography using tetrahedral voxels. *Physics in Medicine and Biology*, 61(18), N497-N513.
5. Reilhac, A., Charil, A., Wimberley, C., Angelis, G., Hamze, H., Callaghan, P., Garcia, M., Boisson, F., Ryder, W., Meikle, S. and Gregoire, M. (2015). 4D PET iterative deconvolution with spatiotemporal regularization for quantitative dynamic PET imaging. *NeuroImage*, 118, 484-493.
6. Gholami, Y., Zhu, X., Fulton, R., Meikle, S., El-Fakhri, G. and Kuncic, Z. (2015). Stochastic simulation of radium-223 dichloride therapy at the sub-cellular level. *Physics in Medicine and Biology*, 60(15), 6087-6096.



Professor Iain McGregor (left) and Associate Professor David Allsop.

# Brain and Mind Centre

## Our donors

Our transformative work would not be possible without philanthropy. In a climate where it has never been more difficult to secure competitive grant funding for our researchers, philanthropy has allowed our innovative research to thrive and importantly, helped to support the future generation of scientific leaders; early-career researchers.

Our focus on translating research into real outcomes that improve patient care and treatments sets us apart from other institutions. As the multidisciplinary home for mental health and neuroscience at the University of Sydney, we are part of an institution with a proven track record of research excellence, which benefits communities near and far. In fact, the University of Sydney is number one in Australia for research impact, according to the 2017 CWTS Leiden Rankings.

When it comes to philanthropy, the impact our donors have on advancing mental health and neuroscience research is very significant. 100 per cent of donations received go directly to funding innovative research that may otherwise not be supported through traditional grant streams.

Unprecedented and monumental donations such as the Lambert Initiative are incredible, but understandably rare. More often, donations support the appointment of specific research staff, enabling us to attract the best talent from across Australia and the world. Over the last two years, we have received more than \$6 million in donations to support research, scholarships and services across child development and behaviour, youth mental health and addiction, and ageing and neurodegeneration.



Associate Professor Muireann Irish works with a patient.

## Supporting Early-Career Researchers

Philanthropy is vital to funding our Early-Career Researchers (ECRs). ECRs in the field of mental health and neuroscience often struggle to gain the vital research experience necessary to win grant funding.

A philanthropic gift allows ECRs to continue to work in their chosen field without having to turn to other research areas where grant funding is perhaps more easily available. By supporting career progression and translational research, we ensure the best talent is attracted to this field and is advancing research our donors care deeply about.

The Bluesand Foundation Scholarship in Alzheimer's disease, for example, will provide \$360,000 to support an ECR as a research fellow for the next three years to undertake translational research in this critical area.

Donations fund our ECRs' work across all areas. The Adolf Blasser Charitable Trust has contributed \$240,000, enabling Joanne Carpenter to transition from PhD student to research fellow.

"The generous support of the Adolf Basser charitable trust has allowed me to commence a post-doctoral position following the completion of my PhD and to continue building on my previous research without stopping to look for other funding opportunities," says Joanne. "This has meant I am able to continue in my area of interest and expertise, and I can focus on extending this important research to provide a deeper understanding of the role of the body clock in mood disorders."

The Johnston Fellowship has also supported work in emerging mood disorders by investigating hormonal therapy and hormonal development in young women. This Fellowship was established in 2014 for two years and was recently renewed for an additional three years, representing an overall contribution of \$625,000.

"My family and I consider the work The University of Sydney's Brain and Mind Centre does to be of great importance in understanding causes and formulating treatment strategies in the area of mental health," says Mr. Johnston. "Its contribution to improving mental health will have a significant impact on outcomes for those affected and the broader community. We understand first-hand the impact hormonal related depression can have and how important it is to advance knowledge and services in this area. Through the Johnston Fellowship we hope to also encourage more promising researchers and clinicians to pursue this important area, helping further develop the Brain and Mind Centre to achieve all it can in serving future generations."

"Bluesand Foundation has long supported Alzheimer's research and we were motivated by both personal experience and our confidence in the University's ability to conduct this important research. We are excited by the work the Brain and Mind Centre is now leading and are pleased to be supporting the next generation of research leaders in this field, who will be critical to advancing this research and making significant breakthroughs."

## High impact philanthropy

One of the largest philanthropic donations over the last two years has come from a private family to establish the Kam Ling Barbara Lo Chair in Neurodegenerative Disorders. This \$1.5 million commitment will help to establish a new Chair in translational research for the next five years. A Chair is the pinnacle of research, and is the most effective way of transforming research and its culture, as Professor Matthew Kiernan, the current Bushell Chair of Neurology, has done so effectively. “Philanthropic donations are vital at every level. From supporting a PhD student to fully funding a Chair position, these gifts allow us to continue our work but also to expand into areas of new focus and attract the best talent to be able to do this,” says Professor Kiernan.

“Our move to a more interdisciplinary method of working will place more focus on examining the links and similarities between neurodegenerative diseases such as Parkinson’s and Motor Neurone Disease and will significantly contribute to our already important work in ageing and neurodegeneration.”

The appointment of the Kam Ling Barbara Lo Chair and a team specifically focused in this direction will allow for a significant increase in the Brain and Mind Centre’s combined efforts to combat disorders of the brain and mind by generating high impact research that translates into improving patient outcomes.

“This new chair, generously funded for the next five years, will enable the Centre to double down on its efforts in finding effective treatments for diseases such as Parkinson’s and Motor Neurone Disease, as well as bring a more strategic approach to the research.”

**Professor Matthew Kiernan**  
Bushell Chair of Neurology

Professor Ian Hickie, Professor Jane Burns and Dr Laura Ospinan demonstrate Project Synergy to the Prime Minister Malcolm Turnbull and former Minister for Health Sussan Ley.



## Measuring impact, working for outcomes

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There has never been a more promising time to support mental health and neuroscience research. The advancements that will emerge in this field over the next five to ten years in particular will transform knowledge and practice and ultimately help to improve outcomes for patients and their families. Philanthropy will remain an essential part of our success and ability to realise these breakthroughs and discoveries.

We deeply value relationships with all supporters and partners who understand the role that high-quality, multidisciplinary and translational research plays alongside clinical services in driving real outcomes. The impact of their support is immeasurable and increasingly pivotal to our success.

To find out more about how you can support our work, please visit

– [sydney.edu.au/brain-mind/donate](https://sydney.edu.au/brain-mind/donate)

## Thanks to our donors

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The Brain and Mind Centre wishes to thank all of our donors. Your generosity keeps our work possible and together we raised over \$6 million in donations June 2015–June 2017.

No gift is too small and we welcome contributions of any size. We wish to particularly thank the following people who donated \$1000 or more. Thank you too to all our donors who wish to remain anonymous and to all those who have contributed over the last two years.

ClubsNSW, The Garnett Passe and Rodney Williams, Memorial Foundation, Estate of the Late Christopher J Wood, Mr Michael R Johnston, Bluesand Foundation Pty Ltd, St Vincent's Private Hospital Sydney, Adolph Basser Charitable Trust, The Mill House Foundation, Future Generation Investment Company, Dr Eleanor Jew, Southern Scene Pty Limited, Mrs Helen Breekveldt, Liberty International Underwriters, Breekveldt Holdings Pty Ltd, Mr Fred Street (AM), Joseph and Clara Vucetic, Harper Bernays Charitable Trust, Parkinson's Society of the Gold Coast Inc.,

The Yulgibar Foundation, John and Catherine McCabe, Mrs Rae Cottle, Mr Ian William Jew, Meeting for Minds Charitable Foundation, Dr Jill M Hawker, Cecil and Richard Churm (OBEMs), Michaella Dupont-Louis, Mrs Christine Windeyer, Mr Alastair Griffin, Hunters Hill Quilters, Estate of the late Santiago Vasco, Macquarie Group Foundation, Mr Heath McLaren, Mr Robert Luciano, Parkinsons ACT Incorporated, Mr Craig Whitworth, Mr David E Landa (OAMMs), Debbie and Zac Seidler, Patricia and Grae McKenzie, Mrs Anne Osborne Sullivan, Craig and Suzanne Whitworth, Follow the Seed Australia Pty Ltd, Mrs Cveta Lillyman, University of Sydney Union, ROAM Communities, Ms Elaine Chang, Conversely, Mrs Hilary Marion Cairns, Ms Eleanor Sydney-Jones, Dr Steven K C Lee, Mr Robert Phillips, Dr Marion G Maxwell, Dr Doug Wilkins, Dr Jean Palmer, Ms Mimi Le, Mr Ian Boyd, Ms Lesley Bradley, Mr Robert A Johnston, AC Monte Sant Angelo College, Mr Leslie P Pongrass, Ms Diane Chaffey, Ms Cara Chriqui, Ms Susan Fielding, Mrs Bunny Gardiner-Hill, Mr Miles Prosser.

# Brain and Mind Centre

## Our teams

Our unique teams consist of academics, researchers, students and professional staff. They are the lifeblood of Brain and Mind Centre. We acknowledge and give thanks for their tireless hard work, diligence and dedication to their research, which can, and is, changing the world.

### The Child Development and Behaviour Team

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#### Academic staff

- Professor Mark Dadds, NHMRC Principal Research Fellow and Professor of Psychology, Team Leader
- Professor Adam Guastella, Principal Research Fellow Psychiatry, Team Leader
- Associate Professor David Hawes, Associate Professor of Psychology, Team Leader
- Associate Professor Natalie Silove, Clinical Associate Professor, Paediatrics and Child Health
- Professor Russell Dale, Professor of Paediatric Neurology
- Dr Meryn Lechowicz, Senior Clinical Psychologist
- Dr Fran Doyle, Senior Project Leader

- Dr Antoinette Redoblado-Hodge, Clinical Neuropsychologist
- Dr Sonia Sultan, Senior Clinical Psychologist
- Dr Christine Song, Postdoctoral Research Fellow
- Dr Lucy Tully, Senior Project Leader
- Antonio Mendoza-Diaz, Postdoctoral Researcher
- Dr Christina Thai, Clinical Psychologist
- Dr Patrycja Piotrowska, Postdoctoral Researcher

#### PhD students

- Bridie Leonard
- Jaimie Northam
- Carrie Fisher
- Kim McGregor
- Marilena Demayo
- Anne Masi

- Shrujna Patel
- Elizabeth Nguyen
- Zahava Ambarchi
- Eleni Demitriou
- Shin Ho Park
- Karen Lesley Pepper

#### Honours students

- Tooba Zaidi

#### Masters students

- Dr Rinku Thapa

#### Professional staff

- Tiffany Sia, Research Assistant
- Emma Thomas, Child Assessment Lead
- Dr Alice Norton, Clinical Research Manager
- Dr Rothanthe Georgiou, Clinical Trial Coordinator
- Dr Izabella Pokorski, Clinical Trial Coordinator

## The Youth Mental Health Team

---

### Academic staff

- Professor Ian Hickie, Program Leader
- Professor Jane Burns, Senior Academic
- Associate Professor Daniel Hermens, Head of Neurobiology stream
- Ms Tracey Davenport, Head of Technology stream
- Mr Shane Cross, Head of Clinical Services Development Stream
- Professor Adam Guastella, Senior Clinical Researcher
- Professor Sharon Naismith, Senior Neuropsychologist
- Associate Professor Louise Nash, Post-graduate Education
- Professor Niels Buus, Suicide intervention
- Professor Sally Cripps, Bayesian statistics
- Professor Jim Lagopoulos, Neuroimaging expertise
- Professor Richard Banati, Neuroimaging expertise

### Professional staff

- Ms Lisa Whittle, Research Product Manager
- Ms Alyssa Milton, Post-Doctoral Research fellow
- Ms Candace Brennan, Office Manager
- Ms Sarah Piper, Research Officer
- Mr Django White, Research Coordinator and Data Manager
- Ms Amelia English, Senior Project Officer
- Ms Natalia Zmicerevska, Research Psychologist
- Ms Alissa Nichles, Clinical Research Officer

### PhD students

- Frank Iorfino
- Ashleigh Tickell
- Jeanne Gehue
- Joanne Carpenter
- Ashlee Grierson
- Peta Eggins
- Casey Paquola
- Dr Laura Ospina-Pinillos
- Vanessa Cheng
- Cate McHugh
- Kate Chitty
- Ange Weinrabe
- Jacob Crouse

### Honours students

- Sophia Bogaty

### Academic and professional collaborators

- Professor Nick Martin
- Professor Paul Amminger
- Professor Cheryl Jones
- Professor Simon Carlile
- Mr John Mendoza
- Professor Pat McGorry
- Professor Jan Scott
- Professor Kathleen Merikangas

## The Psychology Clinic

### Academic staff

- Associate Professor Maree Abbott, Director of Clinical Training
- Ms Shylaja Gooley, Director Psychology Clinic
- Professor Caroline, Hunt Head Clinical Psychology Unit
- Professor Stephen Touyz, Clinical Professor
- Ms Frances Gibson, Clinical Psychologist
- Ms Katy O'Neill, Clinical Psychologist
- Dr David Horry, Psychologist
- Associate Professor David Hawes
- Associate Professor Sunny Lah
- Associate Professor Paul Rhodes,
- Ms Chantal Braganza, Clinical Psychologist
- Professor Louise Sharpe, PG Coordinator

### PhD students

- Amy Leigh Burton
- Jaymee-Lee Chebli
- Elizabeth (Liza) Chervonsky
- Sarah Ellis
- Rosanna Francis
- Catherine (Katie) Gittins
- Andreea Heriseanu
- Ben Huntingdon
- Alice Lo
- Sharlene Mantz
- Claire Mcaulay
- Kimberley Mcgregor
- Matthew Modini
- Melissa Noetel (Fietz)
- Angelique (Angie) Ralph

- Jennifer Read
- Elizabeth Stewart
- Jemma Todd
- Ruth Wells
- Elpiniki Andrew
- Sarah Leila Barakat
- Rachel Brownlow
- Virginia Burgdorf
- Carri Ann Fisher
- Daniel Forrest
- Danielle Gessler
- Lauren Harvey
- Emma Jones
- Brittany Killer
- Cecilia Law
- Bridie Leonard
- Rachel Menzies
- Belinda Poole
- Amy-Lee Sesel
- Stephanie Tesson
- Shannon Webb
- Julia White
- Michael Zhang
- Matteo Zuccala
- Brooke Adam
- Phillip Aouad
- Cate Broomfield
- Madeleine Ferrari
- Jennifer Malecki
- Eileen Seah
- Chloe McGrath
- Nahian Chowdhury
- Rose Iannuzzelli
- Amelia Scott
- Zac Seidler
- Alison Clark

### Masters students

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- Lucy Braude
- Melanie Brookes
- Nadine Devaki-Wright
- Renata Hadzic
- Samantha Joplin
- Cassandra Joslyn
- Aspasia Karageorge
- Daniel Kimber
- Daria Kouznetsova
- Meredith Medway
- Khai Sng
- Jo-Elle Stein
- Valerie Yeung
- Sarah Barrett Jones
- Emily Bartlett
- Rachel Barton
- Melissa Blair
- Alison Clark
- Katherine Dobinson
- Michelle Edwards
- Gavin Entwistle
- Michael Fitzpatrick
- Gracie Garber
- Bree Gregory
- Emma Lamph
- Ben Larke
- Ursula Legoe
- Roisin Lynch
- Lucinda Mairs
- Gregory Martin
- Kristie McDonald
- Teleri Moore
- Alicia Moss
- David Muir
- Claudia Nielson-Jones
- Nurul Praherso
- Greg Quartly-Scott
- Imogen Richards
- Ran Shi
- Avalon Tissue
- Megan Turnbull

## The Gambling Treatment and Research Clinic

---

### Professional staff

- Miss Suzanna Azevedo, Research Assistant/ MCP Candidate
- Ms Brittany Ager, Research Assistant DCP/MSc Student
- Ms Louise Bezzina, Research Assistant, MCP Candidate
- Ms Olivia Schollar-Root, Research Assistant, MCP Candidate
- Ms Belinda Ingram, Education Support Officer
- Ms Cindy Li, Administrative Assistant
- Ms Layal Haydar, Psychology Clinic Receptionist

### Academic and professional staff

- Professor Alex Blaszczynski, Director, Gambling Clinic
- Dr Fadi Anjoul, Deputy Director and Clinical Psychologist
- Dr Sally Gainsbury, Deputy Director, Research
- Ms Kirsten Shannon, Psychologist and Manager
- Christopher Hunter, Clinical Psychologist and Clinical Supervisor
- Janine Bleakley, Psychologist
- Martin Wierczorek, Psychologist
- Ms Jennifer Molinari, Psychologist
- Ms Kerrie Macalister, Provisional Psychologist
- Hanna Kallenberg, Provisional Psychologist
- Trisha Knowland, Provisional Psychologist
- Sarah Rees, Provisional Psychologist
- Michelle Beckett, Project Manager
- Miss Brittany Keen, Research Assistant/ PhD Candidate
- Mr Dylan Pickering, Research Assistant/ PhD Candidate
- Jessica Lam, Research Assistant
- Elle Formica, Intake Officer

## The Neuroimmunology Team Multiple Sclerosis

- Associate Professor Fabienne Brilot-Turville, Principal Research Fellow
- Professor Russell Dale, Paediatric Neurologist
- Professor David Brown, Immunologist
- Professor Steve Vucic, Neurologist
- Dr Melanie Wong, Senior staff specialist in paediatric allergy & immunology
- Dr Sudarshini Ramanathan, Neurologist
- Professor David Booth, Principal Research Fellow
- Professor Graeme Stewart, Clinical Professor of Immunology
- Professor Matthew Kiernan, Bushell Chair of Neurology
- Dr Emily Mathey, Postdoctoral Researcher
- Professor Michael Barnett, Neurologist
- Associate Professor Stephen Reddel, Neurologist
- Associate Professor Michael Buckland, Neuropathologist
- Associate Professor William Phillips, Physiologist
- Professor Stephen Adelstein, Clinical immunologist
- Dr Nicolas Urriola, Clinical immunologist
- Associate Professor Clare Fraser, Neuro-ophthalmologist
- Professor Ian Hickie, Professor of Psychiatry
- Dr Susanna Park, Physiologist

### Academic staff

- Associate Professor Michael Barnett, Team Leader
- Emeritus Professor John Pollard, Professor of Neurology, MS clinician and researcher
- Professor Simon Hawke, Jessie Alberti Senior Principal Research Fellow
- Associate Professor Stephen Reddel, Associate Professor Neurology, neuroimmunology clinician
- Associate Professor Weidong (Tom) Cai
- Dr Judith Spies, MS clinician/researcher
- Dr Jane Frith, MS clinician/researcher
- Dr Todd Hardy, MS clinician/researcher
- Dr Linda Ly, postdoctoral researcher
- Dr Sidong Liu, postdoctoral researcher
- Ms Caitlin Dawes, psychologist

### Professional staff

- Dr Marinda Taha, clinical trials coordinator
- Miss Ishana Dixit, research assistant
- Miss Deleni Walters, research assistant
- Ms Annemarie O'Connell, research nurse/clinical nurse consultant

### MS Fellow

- Dr Justin Garber

### PhD students

- Heidi Beadnall
- Joshua Barton
- Mahtab Ghadiri
- Chenyu (Tim) Wang
- Saeideh Ebrahimkhani

### Students – Engineering/IT and BMC

- Scott Lill
- Suman Regmi
- Antonio Lopes
- Scott Lill
- Mayisha Khan

### Honours students

- Antonio Clark

## ForeFront Ageing and Neurodegeneration Team

### Academic staff

- Professor Glenda Halliday, NHMRC Senior Principal Research Fellow, Professor of Neuroscience, team leader ForeFront Dementia and Movement Disorder Laboratory
- Associate Professor John Kwok, Research geneticist, team leader ForeFront Neurogenetics and Epigenetics Research Group
- Professor Matthew Kiernan, Bushell Chair of Neurology, team leader ForeFront Motor Neurone Disease Research Group
- Professor Steve Vucic, Professor of Neurology ForeFront Motor Neurone Disease Research Group
- Professor John Hodges, Professor of Cognitive Neurology, team leader Frontier Frontotemporal Dementia Research Group
- Professor Olivier Piguet, NHMRC Senior Research Fellow, Professor of Neuropsychology, team leader Frontier Frontotemporal Dementia Research Group
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- Professor Carolyn Sue, Professor and Director of Neurogenetics, team leader Genetics of Parkinson's Disease
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- Dr Claire Shepherd, Director and Facility Manager ForeFront Dementia and Movement Disorder Laboratory
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- Dr Yasi Ke ARC Research Fellow ForeFront animal modelling
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- Professor John Magnussen, Professor of Neuropathology ForeFront imaging
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- Dr Brian Koentjoro, Research Fellow Genetics of Parkinson's Disease
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- Dr Yan Ma, Neurologist and visiting scholar ForeFront Motor Neurone Disease Research Group
- Dr. Yoshimitsu Shimatani, Neurologist and visiting scholar ForeFront Motor Neurone Disease Research Group
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- Chengtao Liang, Research Assistant Frontier Frontotemporal Dementia Research Group
- Dr Karen Crawley, General Practitioner Genetics of Parkinson's Disease
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- Dr Yue Yang, Research Assistant, ForeFront Dementia and Movement Disorder Laboratory
- Eleanor Ramsey, Research Coordinator, ForeFront Motor Neurone Disease Research Group
- Dianne Tyson, Executive Assistant, ForeFront Motor Neurone Disease Research Group
- Margie Zoing, MND Clinical Nurse Consultant, ForeFront Motor Neurone Disease Research Group
- Nicollette Thornton, Clinical Trials and Clinic Coordinator, ForeFront Motor Neurone Disease Research Group
- Tiffany Li, Research Assistant, ForeFront Motor Neurone Disease Research Group
- David Foxe, Senior Research Officer, Frontier Frontotemporal Dementia Research Group
- Dr Leone Chare, Research Officer, Frontier Frontotemporal Dementia Research Group
- Nicole Mueller, Frontier Donor Coordinator, Frontier Frontotemporal Dementia Research Group
- Angela Scharfenberg, Research Assistant, Frontier Frontotemporal Dementia Research Group
- Kelly Nicholas, Research Coordinator, Frontier Frontotemporal Dementia Research Group

**Professional staff**

- Heidi Cartwright, Forefront Coordinator/SRA, ForeFront Dementia and Movement Disorder Laboratory
- Dr Jude Amal-Raj, Team Coordinator, ForeFront Dementia and Movement Disorder Laboratory
- Thomas Cunningham, Database Manager, ForeFront Dementia and Movement Disorder Laboratory
- Ashneeta Kumar, DINAD Participant Coordinator, ForeFront Dementia and Movement Disorder Laboratory
- Marianne Hallupp, Laboratory Manager/SRA, ForeFront Dementia and Movement Disorder Laboratory
- Eve Jary, Research Assistant, ForeFront Dementia and Movement Disorder Laboratory
- Nikita He, Research Assistant, ForeFront Dementia and Movement Disorder Laboratory
- Dr Farzaneh Atashrazm, Research Assistant, ForeFront Dementia and Movement Disorder Laboratory

- Sarah Homewood, Frontier Clinic Administration Assistant, Frontier Frontotemporal Dementia Research Group
  - Jessica Hazelton, Research Assistant, Frontier Frontotemporal Dementia Research Group
  - Annu Mothakunnel, Research Assistant, Frontier Frontotemporal Dementia Research Group
  - Cynthia Murray, Research Assistant, Frontier Frontotemporal Dementia Research Group
  - Nathan Bradshaw, Research Assistant, Frontier Frontotemporal Dementia Research Group
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- Associate Professor Jonathon Arnold, Associate Director, Preclinical Research
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- Dr Lyndsey Anderson, Research Fellow
- Dr Anjali Bhardwaj, Research Fellow
- Dr Jordyn Stuart, Postdoctoral Research Fellow
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- Marieke Graat

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- Miss Eila McGregor, Volunteer
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## The Technical Facilities Team

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- Mr Vince Zappala, Animal Technician
- Ms Debbie Brookes, Assistant Animal Technician
- Mr Mark Elgario, Assistant Animal Technician
- Mrs Sylvia Lohrengel-Kuhner, Administration Manager, Sydney Imaging Core Research Facility
- Dr Govinda Poudel, Senior Technical Officer, Clinical, Sydney Imaging CRF
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