BRAIN RESEARCH NEW ZEALAND

ANNUAL REPORT 2018

The Partnership Issue

Dedicated to the memory of

Nigel Peter Birch

Brain Research New Zealand – Rangahou Roro Aotearoa records the passing of a very dear friend and colleague, Associate Professor Nigel Birch, who was a Principal Investigator within the Centre. Nigel passed away on 23 August 2018 after battling pancreatic cancer. Nigel was greatly admired as an outstanding biochemist and neuroscientist and as a warm, friendly, humble person with very high integrity and values. He loved his work and to many he was a role model for an academic: a passionate, admired teacher who respected and supported his students; a dedicated, thoughtful and successful scientist who brought the best out of those around him; and a committed, collegial member of the university community.

Nigel was a key member of BRNZ who was highly regarded as an outstanding neuroscientist and whose friendly and insightful advice was greatly sought after. He was a major player in the design and delivery of the fundamental science research agenda within BRNZ. He made a very positive contribution to all of its activities, whether it be in unselfishly mentoring younger scientists, working with our outreach programme, or contributing to the research programme of the Centre. He epitomised the ethos of a national centre we were trying to build, with his intellect and his collegial, collaborative, inclusive approach and unstinting willingness to always support the work of the centre and its people.

Nigel will be remembered by us all for his vital contribution, humility and collegiality and his ability as an outstanding researcher ... and his lovely smile and warmth of friendship.

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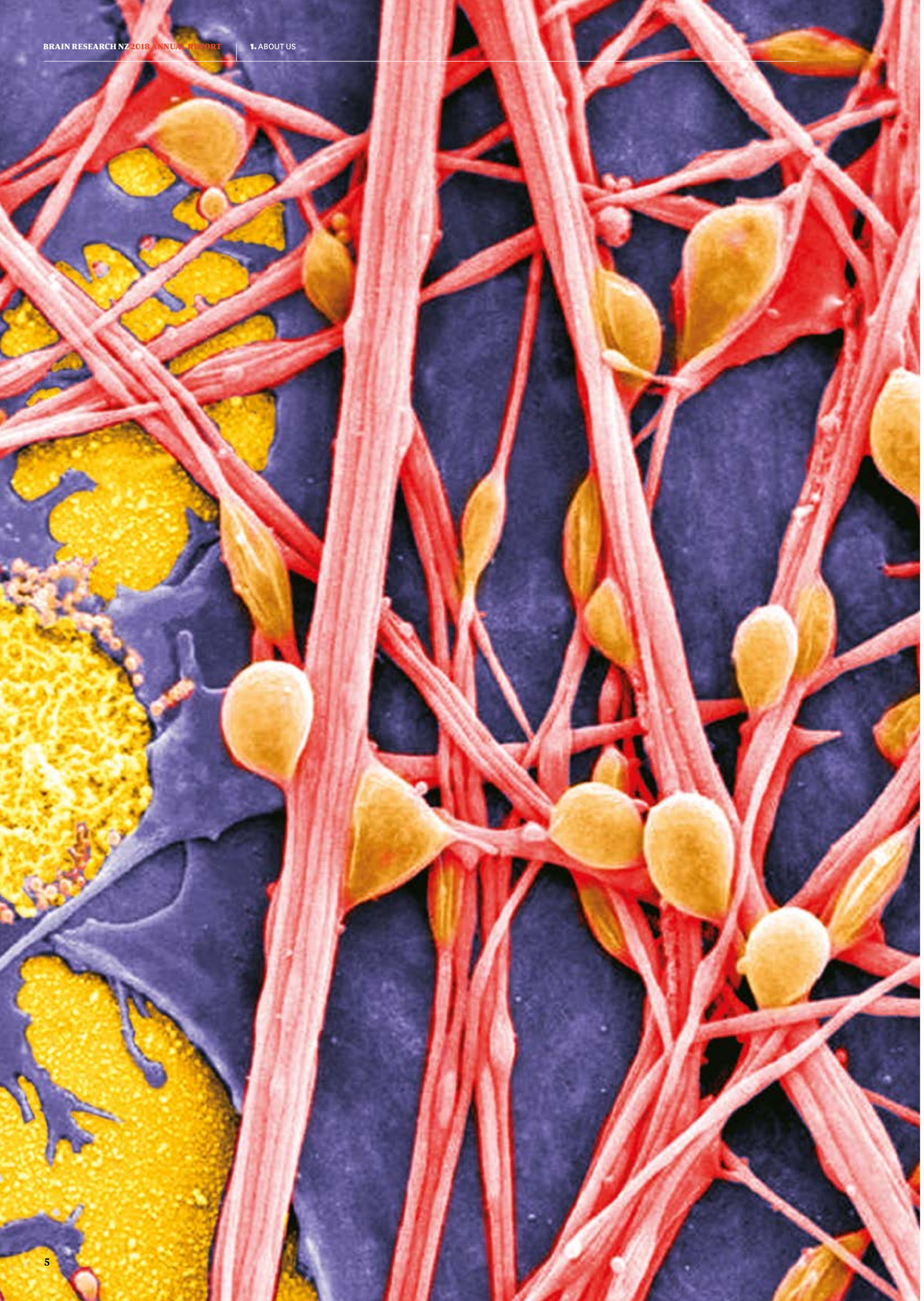


1.

About us

Brain Research New Zealand - Rangahau Roro Aotearoa (BRNZ) is a national Centre of Research Excellence (CoRE) undertaking ground-breaking research on the ageing brain and ageing-related neurological disorders. We bring together New Zealand's leading neuroscientists and clinicians and work with community organisations to combat neurological disorders such as stroke, Parkinson's and Alzheimer's diseases – some of the greatest medical and social challenges of our generation. BRNZ's interdisciplinary approach, founded on excellence and innovation, is the driver for undertaking translational research, with the ultimate aim of improving brain health for all New Zealanders in the years to come.

2.

From the Co-Directors

Prof. Cliff Abraham

Prof. Peter Thorne

Every year, we as Co-Directors like to reflect on and take stock of what our CoRE and its extraordinary researchers have achieved in the year gone by. And while we could never capture everything here, we have tried to highlight a few noteworthy achievements of 2018 that demonstrate the value of our research. Importantly, we also highlight here the value of working together, the underlying theme of this annual report.

As a co-hosted CoRE, Brain Research New Zealand is the embodiment of interinstitutional and interdisciplinary collaboration. We are immensely proud to have seen it unite researchers and clinicians across New Zealand's leading universities, and connect with Māori and other communities, to tackle one of our country's most challenging problems – disorders of the ageing brain.

But our vision – lifelong brain health for all New Zealanders – is not something we can achieve alone, nor in a short time.

Since BRNZ began, we have set out to weave a diverse network of partnerships with community groups, DHBs, Māori communities, schools, industry, and research entities both domestically and abroad. These partnerships each make up an important thread of our CoRE, and have enabled us to advance the world-class research and community outreach that we undertake every day.

The results are clear: partnership with community groups such as Alzheimers New Zealand has helped us improve awareness of dementia across New Zealand; partnership with Māori is helping us develop a community-led peer support system for Māori who have suffered a stroke; work with the South Australian Research and Development Institute (SARDI) has resulted in the development of a world-first sheep model of Alzheimer's disease (AD); uniting with researchers in China has led to promising research into Chinese medicine as a treatment for tinnitus; partnership with New Zealand primary and intermediate schools has enabled us to spark a passion for the studying the brain in thousands of kiwi kids; joining forces with the MedTech CoRE is helping us to advance research into a novel method for delivering drugs to the inner ear; and co-funding projects with the Ageing Well National Science Challenge to implement programmes amongst Māori and Pasifika to reduce stroke risk and combat early dementia. These are just a few of the exciting partnership examples to be found on the pages that follow.

BRNZ's research programme is driven by the best neuroscientists in New Zealand, but our true strength lies in the partnerships that we have forged, and our shared commitment to improve quality of life for New Zealand's ageing population.

It is with a focus on the value of partnership that we share with you our 2018 annual report.

3.

BRNZ in brief

OUR PEOPLE

4
76 research groups from 4 leading New Zealand universities

125
doctoral students

14%
of our members identify as Māori

58% (male) **42%** (female)
membership base

RESEARCH EXCELLENCE

201
peer-reviewed research papers and book chapters

$17M
Over $17 million in new external funding

2
patent applications

11%
of members are Fellows of the Royal Society of New Zealand

Collaborations with 10 countries worldwide

DEMENTIA PREVENTION RESEARCH CLINICS

3 Dementia Prevention Research Clinics in Auckland, Christchurch and Dunedin

158 people enrolled in the DPRC study

5
Partnerships with 5 District Health Boards

15
studies underway using DPRC samples or data

WORLD CLASS TRAINING ENVIRONMENT

186 graduate students

30 qualification completions

65 postdoctoral fellows

60% (female) **40%** (male)

32 Early Career Researchers (ECRs) presented their work at prestigious international conferences **32**

MĀORI ACHIEVEMENT

6
early career Māori researchers conducting health research for Māori

$2M
invested in Māori-specific research projects

8
Māori-specific research projects

6
Northland Māori secondary schools participating in the Brain Bee Competition

COMMUNITY ENGAGEMENT

3000+
people attended our national dementia prevention talk series with Alzheimers New Zealand

"Every Three Seconds" ITN documentary viewed in over 100 countries worldwide

245
schools signed up to use the Being Brainy programme

$4M Over $4million in philanthropic funding raised

BRNZ researchers were in the media on average twice a week

4.

Our goals for New Zealand

Our vision:

Lifelong brain health for all New Zealanders.

Our mission:

To unlock the secrets of the ageing brain and develop new therapies and better clinical and community care to enhance life-long brain health for all New Zealanders.

Our goals:

1. **Better health outcomes, improved quality of life and positive ageing for older persons and their families, including reduced physical, emotional, social and financial costs of ageing-related neurological disorders, through public dissemination of the latest research and the creation of partnerships with patients, families, community organisations and NGOs across NZ.**
2. **A Centre of Neuroscience Research Excellence that is nationally and internationally recognised and sought after for its expertise and innovation in the study of the ageing brain.**
3. **Improved strategies for prevention, early detection and slowing of progression of ageing-related neurological disorders, through identification of early biomarkers and an improved understanding of the mechanisms of ageing-related neurological disorders.**
4. **Improved clinical practice by translating scientific knowledge into treatments, strategies and care pathways aimed at delaying or moderating ageing-related neurological disorders.**
5. **Increased scientific, clinical, translational and leadership capability that will improve research output, patient outcomes, productivity and health industry research capacity.**
6. **Improved Māori health and wellbeing during ageing by working with Māori communities to understand their needs and value and build equal relationships, incorporating Mātauranga into innovative research and clinical methods, and by supporting Māori to determine their own pathways to brain health through training of Māori neuroscientists and clinicians.**

5.

Research excellence

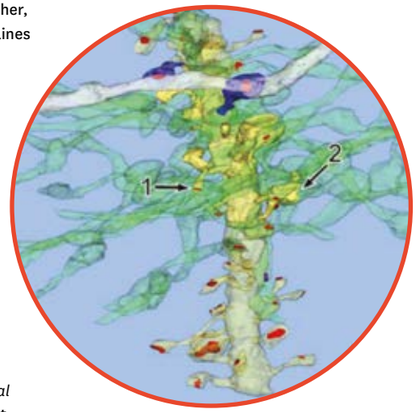
As one of New Zealand's Centres of Research Excellence, BRNZ's core mission is to undertake research of the highest quality that is aimed at understanding what makes for a healthy brain during ageing. Accordingly, our research programme focuses on revealing the causes, pathology and sociocultural features of ageing-related neurological diseases. Along the way, we are learning more and more about what constitutes normal ageing of the nervous system, and how healthy ageing can be promoted and prolonged. We are using this acquired knowledge to help find new therapies and interventions that may delay the onset of brain disorders, treat them once they occur, and generally improve the quality of life for New Zealand's ageing population.

Of course our research is not done in a vacuum. Rather we are part of a global effort to reduce the world's burden of ageing-related neurological disorders. It is critical therefore that our research teams connect their work with leading groups both elsewhere in New Zealand and internationally so that by sharing resources and ideas, greater outcomes can be achieved, and more quickly. Teamwork and partnerships make up the fundamental ethos for achieving excellence in research amongst the CoRE investigators, and this is equally true for our linkages with research groups outside the CoRE. Here we give a snapshot of a number of our exciting research projects across the four main Themes of our activity, highlighting where external partnerships are making critical contributions.

NEURODISCOVERY AND DISEASE MECHANISMS

RESEARCH HIGHLIGHTS

Understanding how nerve cells in the brain connect with each other, and change those connections during learning, is one of the key lines of research for revealing how those mechanisms are affected in disorders of memory and cognition, such as Alzheimer's disease. Prof. John Reynolds, with a team of researchers from the UK, has generated new understanding of how the neural circuits within the striatum coordinate their activity during behaviour (reported in the international journal *Neuron*). The striatum is a brain region that is critical for learning based on reinforcement of behaviours, and is badly affected in Parkinson's and Huntington's diseases. Working on another memory-related structure, the hippocampus, which is affected early in Alzheimer's disease, Prof. Abraham and researchers in the USA undertook detailed 3-D anatomical reconstructions of synapses and how they are modified by a learning-like experience. They found an unexpected combination of both expanding and shrinking synapses that appears to store the memory while retaining an overall stability of function in this brain region (*Proceedings National Academy of Sciences, USA*). Computer modelling by Prof. Tim David and BRNZ PhD student Allanah Kenny have revealed how various cell types in addition to nerve cells coordinate their activity to control blood flow to the specific brain regions (*J Computational Neuroscience*). A disruption of brain circuitry in Alzheimer's disease has been made evident by Dr Andrea Kwakowsky and BRNZ colleagues who have discovered in post-mortem human brain tissue changes in the expression of molecules important for inhibitory signalling (*J Neurochemistry-a*). They have proposed that these molecules could represent therapeutic targets for tackling the disease (*J Neurochemistry-b*). Prof. Dirk De Ridder with colleagues in Texas and Korea have used brain wave recordings in humans across a variety of conditions such as Parkinson's, chronic pain and tinnitus to confirm that disorderly brain signalling is fundamental to each disorder, with both commonalities and differences in the patterns of disrupted brain signals across conditions (*Nature Communications*). Promisingly, Prof. John Dalrymple-Alford and colleagues have shown that exposure of rats to enriched environments helps them recover normal brain signalling and memory after stroke (*Hippocampus*). Associate Prof. Johanna Montgomery has been working on a therapeutic approach to Huntington's disease (*Hippocampus*), while Dr Monica Acosta and colleagues in Sydney have new findings regarding a neuroprotective compound against stroke damage in the retina (*Experimental Eye Research*).



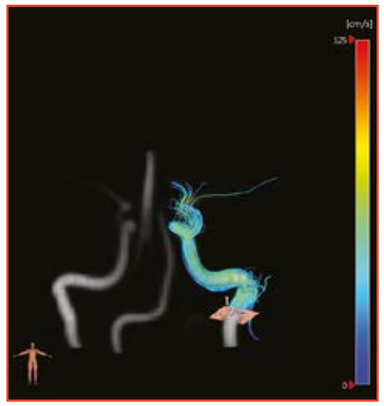
***Above:** A 3-D anatomical reconstruction of a few nerve cell synapses imaged using electron microscopy. Green, incoming fibres; yellow, a receiving nerve cell process with tiny protrusions called spines (two are highlighted in blue); red, points of synaptic contacts.*

RESEARCH THEME 2

NEUROBIOMARKERS AND DISEASE INDICATORS

RESEARCH HIGHLIGHTS

Understanding neurological disease development, as well as the molecular indicators that predict disease onset or recovery from brain damage, are vital elements of the attack on neurological disorders. Having predictive "biomarkers" would enable commencement of treatments before significant brain damage occurs, and can be used to track the effectiveness of treatments or interventions. Biomarkers that can be screened to add value to standard clinical/cognitive assessments range from molecules in the blood or other tissues, to markers found through brain scanning, to behavioural measures. Using animal models of Alzheimer's, Associate Prof. Joanna Williams and Dr Margaret Ryan have shown that patterns of expression of small molecules in plasma called microRNA relate to the development of disease impairments, as well as to normal ageing processes in control animals (*J Alzheimer's Disease*). Another study by Associate Prof. Ping Liu and colleagues has revealed that a family of plasma molecules related to the amino acid arginine also change their expression in a way that relates to the development of memory impairment (*Translational Psychiatry*). In a thought-provoking review, Prof. Russell Snell and Distinguished Prof. Sir Richard Faull along with colleagues from Australia have discussed the advantages and limitations of breath analysis in diagnosing and monitoring neurodegenerative disorders (*Brain Research*). On the motor side, Prof. Bronwen Connor has reported data that gait analysis may prove useful for early detection of Parkinson's disease (*Frontiers Behavioral Neuroscience*). More directly related to brain function, Dr Catherine Morgan, Associate Prof. Lynette Tippett and many other BRNZ colleagues have been developing new MRI scanning techniques for detecting early cognitive impairment (*Alzheimer's and Dementia*), while Prof. Ian Kirk and BRNZ PhD student Meg Spriggs have been studying brain wave plasticity in response to visual stimuli as an alternative measure of early cognitive decline (*Neuroimage*). Biomarkers for stroke recovery are being intensively studied as well, with a combined cognitive and blood molecule assessment of interest to Profs Cathy Stinear and Winston Byblow (*Neurorehabilitation*).



***Above:** Dr Catherine Morgan's work on "4D-Flow"* MRI in the brain – a method that provides both morphology and haemodynamic information, here showing the flow pattern and velocity of blood in the left internal carotid artery, in collaboration with Dr Tracy Melzer.*
**Thanks to Drs Ning Jing, Andreas Greiser, and Sinyeob Ann Siemens Healthcare, for the provision of the 4D phase contrast Flow Imaging prototype (WIP) sequence.*

RESEARCH THEME 3

HARNESSING AND DIRECTING NEUROPLASTICITY

RESEARCH HIGHLIGHTS

Neuroplasticity is fundamental to learning and memory formation, brain development, and recovery from brain disease or injury. Finding ways to effectively harness the brain's natural capacity to change in response to experience or stimulation is central to a number of research programmes in BRNZ. Stroke is one disorder in which facilitation of plasticity to enhance recovery of function by the surviving tissue is a key objective. Non-invasive stimulation techniques are of particular interest, and both Prof. Byblow (*Brain Stimulation, Experimental Brain Research*) and Prof. De Ridder (*Frontiers Human Neuroscience*) have been on the hunt with national and international colleagues to find optimally effective stimulation protocols in both normal ageing and across a variety of neurological conditions. A completely different and novel approach, entailing counterpulsation pressure waves delivered to the lower limbs, shows promise as a way of increasing blood perfusion the brain and enhancing neuroplasticity, as recently reported by Prof. Stinear and colleagues in Hong Kong (*J Neurology, Neurosurgery, Psychiatry*). Transcranial stimulation is also under study by Associate Prof. Liana Machado for improving voluntary control of rapid eye movements, which declines during normal ageing (*Vision*). It may also be useful in improving verbal working memory if applied over the frontal lobe, although the jury is still out on the reliability of such treatments, as reviewed recently by Associate Prof. Machado (*J Clinical and Experimental Neuropsychology*). Associate Prof. Montgomery is interested in yet another kind of neuroplasticity that may reside at the neural innervation of the heart. Such plasticity may not only fine-tune autonomic innervation of the heart, but could also be a source of maladaptive plasticity during atrial fibrillation (*Frontiers Physiology*). Finally, brain plasticity to improve brain functioning after stroke or other neurological disorders may require stimulation within the brain tissue itself, much like the deep-brain stimulation that is used to treat Parkinson's disease. State-of-the-art optogenetic stimulation, a technique that offers a number of advantages over electrical stimulation is now being increasingly explored, including by Associate Prof. Louise Parr-Brownlie and Prof. Dalrymple-Alford (*Hippocampus*).

***Above:** Associate Prof. Liana Machado investigates whether voluntary control of rapid eye movements can be improved via transcranial direct current stimulation.*

PREVENTION, INTERVENTION AND DELIVERY

RESEARCH HIGHLIGHTS

As its title suggests, the scope of Theme 4 is broad. Yet the BRNZ team has been working to make a difference across all three domains.

There is a growing body of evidence that activity is a fundamental part of life that can delay onset of a number of neurological disorders. Associate Prof. Stinear, for example, has shown that a course of training with poi is as effective as Tai Chi in improving cognitive and physical health of older New Zealanders (*J Aging Physical Activity*). In a study of advanced ageing, Prof. Ngaire Kerse along with Australian colleagues found that higher levels of physical activity were associated with lower mortality and higher functional status in advanced-aged adults, for both Māori and non-Māori (*J Aging Physical Activity*). Exercise can also give holistic benefits to Parkinson's disease patients, as shown by Prof. Leigh Hale (*NZ J Physiotherapy*). At a cellular level too, Associate Prof. Phil Sheard has found that exercise ameliorates the ageing-related decline in motoneuron number and neuromuscular health (*Geroscience*). There are other ways however to achieve the benefits of activity. For example, Associate Prof. Machado and BRNZ PhD student Hayley Guiney have reviewed the literature on volunteering, and found that volunteering can protect against cognitive ageing with respect to global functioning and at least some specific cognitive domains, consistent with advice to older people to remain socially engaged.

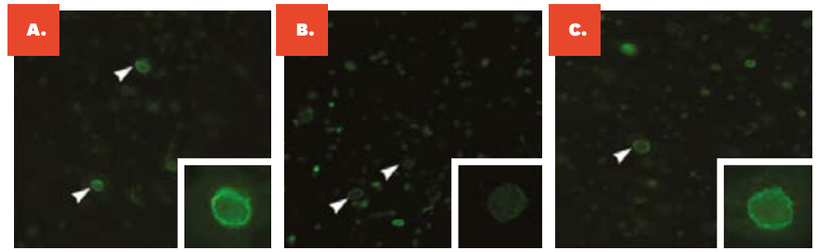
In the field of stroke, Prof. Valery Feigin, Dr Rita Krishnamurthi, BRNZ PhD student Ann George and colleagues including those from Australia and the UK have shown in a feasibility study the potential value of a mobile app in raising awareness of stroke risk factors and providing guidance for risk reduction (*Stroke*). Importantly, this team and including other BRNZ researchers Prof. Alan Barber, Prof. Suzanne Barker-Collo and Dr Hinemoa Elder have reported initial results from a clinical trial that after nine months, a Health and Wellness Coaching programme led to a substantial relative risk reduction of five-year cardiovascular disease risk (*International J Stroke*). The trial is ongoing with BRNZ support, and we await the final outcomes with great interest. Other trials that BRNZ researchers are engaged in include a Phase IIb study of the effectiveness of porcine choroid plexus cells for Parkinson's disease patients (*Parkinsonism and Related Disorders*), a feasibility study of surf-like sounds for treating tinnitus using personal music players by Associate Prof. Grant Searchfield (*International J Audiology*), and a feasibility study for improving appropriate polypharmacy for older adults in primary care by Prof. Ngaire Kerse and colleagues (*Pilot Feasibility Studies*).

Finally, examples of studies that may affect health service delivery include a study of the presentation of dementia by Māori and Pacific Islanders by Prof. Sarah Cullum (*Int J Geriatric Psychiatry*), development of an otitis media strategy in the Pacific by Prof. Peter Thorne (*NZ Medical J*), development of a toolkit to enhance care processes for people with a long-term neurological condition by Associate Prof. Nicola Kayes and colleagues (*British Medical J Open*), and a study by Prof. Suzanne Purdy, Prof. Cullum and colleagues in the UK that dementia patients are less likely to be transported to hospital after an emergency than non-dementia patients (*British Medical J Open*).

Globally, neurological disorders ranked as the leading cause group of disability and the second leading cause of deaths in 2015, with Alzheimer's and other dementias being one of the leading contributors (Prof. Valery Feigin, *Lancet Neurology*). Thus the development of effective preventive or treatment measures is critical, although enhancing the service delivery to those already with ageing-related neurological disorders is equally important. Understanding the needs of health care workers and valuing their work is an important element in quality care, an issue that Prof. Leigh Hale has been championing (*Ageing and Society*). She has also been pioneering ways to assess how stroke survivors reintegrate into society (*Edorium J Disability and Rehabilitation*). Of importance, there is a growing awareness of cultural differences between Māori and non-Māori in their links to the home and environment and how this is related to health measures during ageing (*Social Science and Medicine*). The types of preferred activities across these groups is also of interest, as their ability to engage in them is likely to be related to health outcomes during ageing as well (*J Cross Cultural Gerontology*).

Above: **Te Puāwaitanga O Ngā Tapuwae Kia Ora Tonu/Life and Living in Advanced Age, *a Cohort Study in New Zealand, otherwise known as LiLACS NZ, community groups.***

Importantly, BRNZ is funding a number of intervention studies aiming to improve cognitive function and quality of life in those with dementia or its antecedent, mild cognitive impairment (MCI). Such programmes include Cognitive Stimulation Therapy (Dr Cheung), Cognition and Exercise training (Prof. Kerse), combined physical and mental exercise for Parkinson's disease (Prof. John Dalrymple-Alford, Prof. Leigh Hale), and a lifestyle-change pilot study (Prof. Kerse). We eagerly await the outcomes of these trials and programmes. In a novel and intriguing study, the use of home-care robots for improving the quality of life for those with MCI and early dementia has also begun to be explored, with proposals for how to advance this approach having recently been published (Prof. Kerse, *J American Medical Directors Association*).

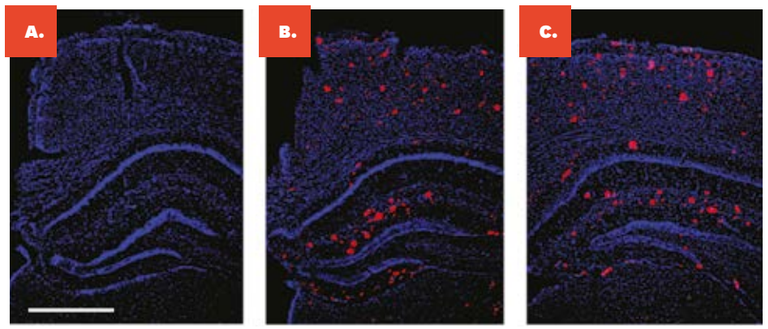


Above: ***Associate Prof. Phil Sheard's study asked whether loss of specific proteins at the nuclear envelope contributes to death of nerve cells in old age, and also whether exercise prevents any such loss. The team found that a number of important nuclear proteins decline in old age (in mice) and that this correlates with nerve cell death. By contrast, mice that exercised for several months into their old age showed a much reduced decline in these nuclear proteins and reduced levels of neuron death. The figure shows immunostaining for the nuclear protein nucleoporin 98 in motoneurons in the spinal cords of young mice (A.), sedentary old mice (B. - reduced protein levels) and exercised old mice (C. - normal protein levels).***

A very special protein:

Reducing deficits in Alzheimer's disease through gene therapy

Alzheimer's disease, the most common form of dementia, is a degenerative brain condition that progressively impairs memory, thinking and reasoning skills. It is estimated that it affects 10% of New Zealanders over 65 years and 25% of people over 85. Currently, there is no cure. But there is hope: the international field of Alzheimer's disease research is massive and scientists are investigating a range of potential therapeutic treatments. One of these is the use of a neuroprotective protein known as "sAPPα", something that Prof. Cliff Abraham and Associate Prof. Stephanie Hughes along with other colleagues from the University of Otago have been working hard on figuring out.



***Above:** Gene therapy, delivering the therapeutic protein secreted amyloid precursor protein-alpha in a mouse model of Alzheimer's disease, was found to restore memory function and brain plasticity to normal levels. Interestingly, this occurred without changing the brain pathology, as illustrated in these representative brain sections showing Alzheimer's pathology (red stains) for a) a normal mouse, b) an Alzheimer's mouse with gene therapy, and c) an Alzheimer's mouse without gene therapy. The gene therapy thus enhanced brain resilience against the disease pathology.*

"The thing that's always captured my imagination," Cliff says, "is how the nervous system operates in a way that learning can actually occur. And it's important to think about how our understanding of the normal and basic mechanisms might become impaired in disease conditions." Alzheimer's disease, which is characterised by early memory problems, seemed like the natural place to look.

Some years ago, Cliff and his collaborators, including Prof. Warren Tate and Associate Prof. Joanna Williams, developed an interest in a positively acting protein called secreted amyloid precursor protein-alpha, or sAPPα for short. The protein is known for its ability to improve learning and memory, synaptic plasticity, and neuronal survival. It is also known that in Alzheimer's disease, sAPPα production is reduced while the toxic amyloid-beta peptide increasingly accumulates in the brain.

Even though the therapeutic potential of sAPPα has been promising, there has been no easy way of delivering it to an animal over a long period of time. The protein normally has to be injected directly into the brain, as it cannot cross the blood-brain barrier (which protects the brain from all kinds of "nasty things" in the bloodstream). However, repeated injections into the brain are just not very practical.

But the arrival of Associate Prof. Stephanie Hughes at the University of Otago opened up new possibilities. In the USA, Stephanie had developed techniques to use viral vectors for gene therapy and brought them back to New Zealand. "Instead of having to inject the protein every day," Stephanie explains, "we can inject a virus, which delivers the gene that allows expression of that protein by nerve cells. It actually integrates that bit of genetic material into the cells. So it's a permanent delivery system, a long-term therapeutic option." And it was exactly what Cliff and his team had been looking for.

They were finally at a point where they could test the therapeutic potential of sAPPα in an animal disease model. Valerie Tan, a PhD student supervised by Stephanie and Cliff, conducted a study to see if they could get long-term expression of sAPPα in the brain to ameliorate the deficits seen in a mouse model of Alzheimer's disease. They used a one-off injection of a lentiviral vector, a method by which genes can be inserted or modified, and supported by the BRNZ funded Mārama viral vector platform, to express human sAPPα in the nerve cells of a brain area called the hippocampus. The mice, including control groups, went through a series of behavioural tests, some of which showed that sAPPα indeed had therapeutic effects. The treatment with sAPPα prevented deficits in spatial memory tasks – for example, the animals treated with the protein performed better in a water maze test than the untreated animals.

"The thing that's always captured my imagination," Cliff says, "is how the nervous system operates in a way that learning can actually occur. And it's important to think about how our understanding of the normal and basic mechanisms might become impaired in disease conditions."

When analysing the tissue, the researchers also found that sAPPα affected a synaptic plasticity process called long-term potentiation. "Learning is about changing the connectivity between nerve cells," Cliff explains, "so that the ones representing a particular experience become more strongly connected, which makes it easier to recall a memory later on. Long-term potentiation is this process of strengthening synaptic connections." In this work published in *Molecular Brain*, the researchers showed that the treatment with sAPPα was able to partially rescue long-term potentiation and that deficits could even be fully restored – making it easier to remember events and experiences.

So, what does this all mean for Alzheimer's patients? Will sAPPα and gene therapy be a viable treatment option? "Gene therapy is certainly coming," Stephanie says, but there are still some hurdles. The biggest one at the moment is the lack of reliable biomarkers, so that one can predict early on whether someone will get Alzheimer's disease. Still, gene therapy trials for other therapeutic agents in Alzheimer's disease are already happening, so a treatment with sAPPα is a possibility.

While our researchers are not putting all their eggs in the sAPPα basket, it certainly is a promising option. "We have found a rescue of brain function without apparently affecting the disease process itself," Cliff explains. "The hope of sAPPα lies in enhancing cognitive reserve and nerve cell resilience to stave off the effects of the disease for longer." And indeed, if we could delay the onset of the disease by five years, we could cut down the incidence quite substantially.

Knocking out proteins on the hunt for treatments

PROF. MIKE DRAGUNOW

In Prof. Mike Dragunow's lab at the University of Auckland, they grow human brain cells – everything from star-shaped astrocytes and neurons, to the focus of his latest research paper, microglia – the brain's "surveyors". For the past twenty years, BRNZ Principal Investigator Mike Dragunow and his team have worked to better understand the molecular mechanisms of neurodegeneration and repair. And in a recent issue of the prestigious journal *Molecular Neurodegeneration*, they report on work that could have implications for the treatment of Alzheimer's.

Microglia play a vital role in the brain's immune system, so they have long been a target of Mike's research. "Microglial cells are often involved in inflammation in the brain," he explains. "So for many years we've used them, and the molecules they secrete, as a way to understand those processes." One molecule that's of particular interest is the protein PU.1, which sits in the nucleus of all microglial cells.

From earlier work, Mike knew that PU.1 controls a process called phagocytosis – this is the way in which microglia devour other materials present in the brain. "This is one of the cell's most basic functions," he says, "but by knocking out the protein, we managed to significantly inhibit that ability." Stopping microglia from engulfing other materials is widely believed to have implications for treating brain disorders, though there is some debate on the details. So, Mike and his team set out to explore the idea, by looking at the follow-on effects on other genes of removing PU.1 in human microglial cells.

"When we got rid of the PU.1, we found changes in a number of genes," he explains, "but two in particular – TREM2 and DAP12 – are associated with Alzheimer's disease. So, we realised that PU.1 could be a potential therapeutic target." In other words, if they could find a drug compound that reduced levels of PU.1 in microglial cells, it might also limit some of the genetic changes linked to Alzheimer's.

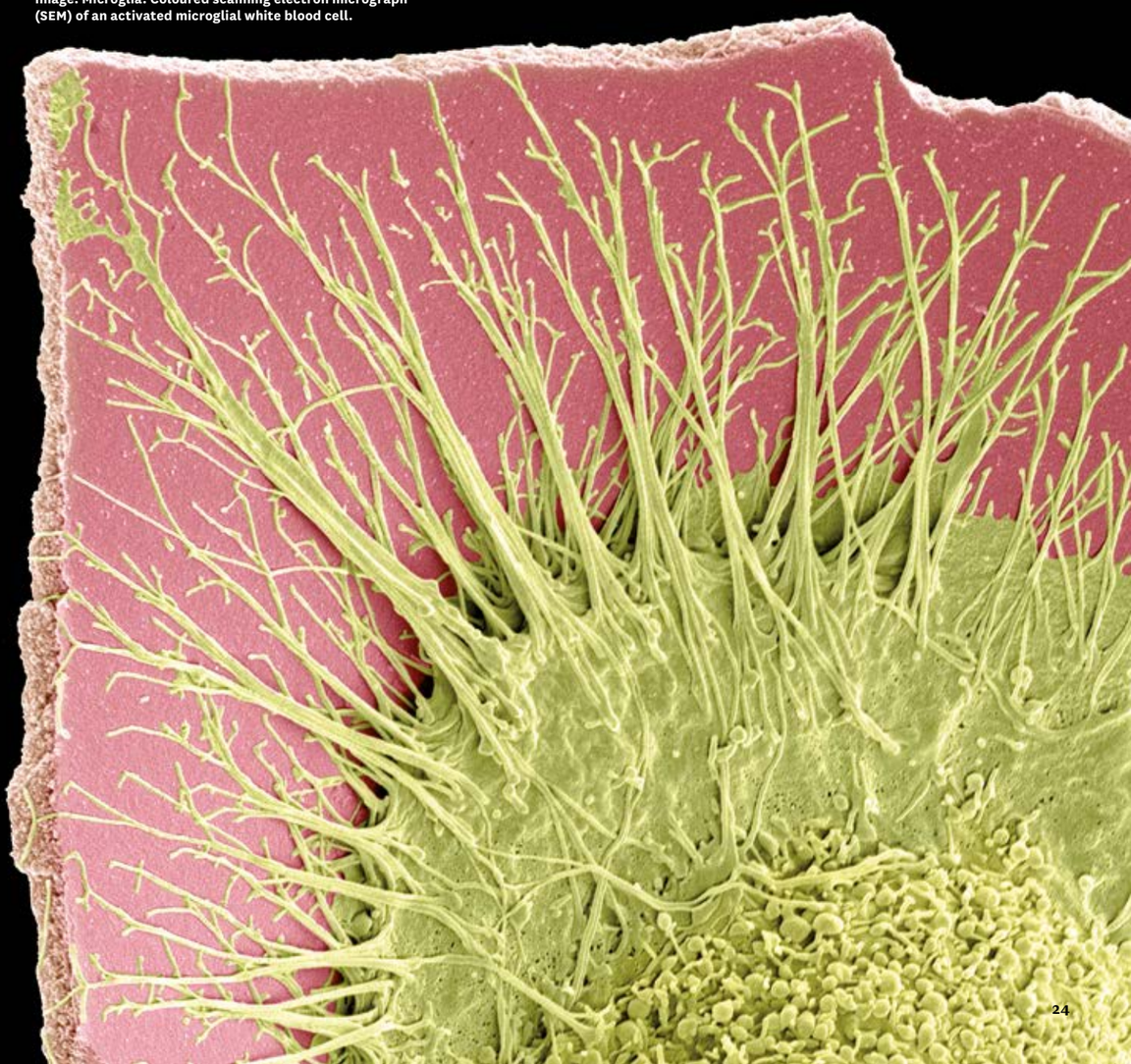
In their study, they trialled a library of 1,280 FDA-approved drug compounds. Only one, Vorinostat, which is used in cancer treatments, had the desired effect. But that was enough for Mike, who says, "It was really quite exciting to see the effect of Vorinostat on the cells, and it's given us a new path to explore. I'm a neuro-pharmacologist, so I want to get effective drugs into the clinic."

Their work on PU.1 is ongoing, and it is very much an international affair. Alongside researchers from across the University of Auckland, Mike is joined by colleagues at Imperial College London and the University of Virginia. What unites them is the use of human brain tissue over animal models, something that Mike, as Director of the Hugh Green BioBank is passionate about. "Humans are full of variation, but I'd argue that including that, strengthens studies" he says. "If we can find a drug that works in the microglia of people from different backgrounds, we can be a bit more confident that it might work more generally."

"If we can find a drug that works in the microglia of people from different backgrounds, we can be a bit more confident that it might work more generally."

PROF. MIKE DRAGUNOW

Image: Microglia. Coloured scanning electron micrograph (SEM) of an activated microglial white blood cell.



A cellular approach to stroke recovery

Every year in New Zealand, around 9000 people have a stroke, and as our population ages, that number is expected to rise. In many cases, those affected never recover fully and disabilities can last decades. This is why BRNZ researchers have been working on all aspects of stroke – from preventing them via education, through to developing novel therapies.

University of Otago's Dr Andrew Clarkson is interested in processes that occur at a cellular level, during and after a stroke. "Adult brains show a limited capacity for neural repair," he says. "We know neurorehabilitation can promote partial recovery, but the actual cellular repair mechanisms have not been well-defined."

Andrew has been working to change that for more than a decade, because to him, understanding these repair mechanisms could be the key to developing better therapies. While based at UCLA in 2010, Andrew and his colleagues had a breakthrough. Working with mice models, they showed that, several days after a stroke, there is an excess of a neurotransmitter called GABA in the brain. GABA's job is to regulate how excitable the brain gets, so it plays a vital role in maintaining brain health. But if there's too much GABA – as there is post-stroke – it can silence the brain's networks of activity. Andrew believes that this is an intrinsic mechanism gone wrong, "The brain is producing GABA as a way to minimise the spread of damage, but somehow, it just doesn't turn itself off. We think this is one of the main reasons people don't recover well from stroke."

In that same study, Andrew's team found that if they could interrupt the runaway process, and normalise levels of GABA, they could recover some of the brain's cell function. In effect, if they could find drugs that better target specific parts of the receptors, they could amplify the brain's natural self-protect mechanism. "We felt that this approach would give us better outcomes than previous drug trials," he says, but this was an entirely new way to look at recovery.

When Andrew returned to New Zealand, he assembled an international team of researchers. All of the animal work was done at the University of Otago, with initial drug compound tested at the University of Sydney. A team at Monash University examined how the drugs crossed the blood-brain barrier, and at Denmark's Aarhus University, electrophysiology was performed on brain tissue. The team published their results in a recent issue of *Journal of Cerebral Blood Flow & Metabolism*.

To date, they've screened fifteen drugs, systematically testing each one to check its effectiveness on their target receptors. "There are a few candidates," says Andrew. "We think the most promising drug actually targets receptors found both in the brain and on immune cells." This is unique – a double-whammy of cell protection – and it could buy stroke sufferers more time to recover brain function. The saying among stroke researchers is, "Time is brain cells," so although it's still early days, Andrew's work could prove to be very valuable indeed.

Could sheep hold the key to unlocking Alzheimer's?

PROF. RUSSELL SNELL

"Our animal models wander around in paddocks, eat grass, and are well cared for. In many ways, they're just normal sheep," says BRNZ Principal Investigator, Prof. Russell Snell. But those sheep are special, because they're helping Russell and his colleagues at the University of Auckland to better understand the function of genes in neurodegenerative conditions.

Russell's research into Huntington's disease started 30 years ago. He was part of the pioneering team that first identified HTT, the gene behind the condition. Since then, his interests have expanded to include Alzheimer's, and neurodevelopmental disorders such as Autism. "I'm interested in a lot of stuff," he says. "And I'm not loyal to any one technique – I just want to use the best tool for the job. If it doesn't exist, we'll develop it ourselves." That was certainly the case with his sheep model for Huntington's, which he first developed ten years ago. "We know what the gene for Huntington's is. Now the challenge is to search for the earliest indicators of changes in that gene," Russell explains. "The sheep give us a unique opportunity to do that."

Using his model, the team found that, long before the sheep display any symptoms, there is a build-up of urea in their brain tissue. Urea is usually produced by the liver from ammonia, but according to Russell, there is some precedent for neurodegenerative diseases starting outside of the brain. "The hypothesis is that this urea is caused by disruption in the body's normal Ammonia-handling processes. If that's the case, it might be possible to repurpose existing treatments, and use them to delay the onset of Huntington's. That's the dream."

Russell has confirmed his urea findings in human brain cells, thanks to his link with the Neurological Foundation Human Brain Bank, run by Prof. Maurice Curtis and Distinguished Prof. Sir Richard Faull. "This hypothesis will either be right or wrong", he laughs, "We're working hard to find out which – either way, it will be valuable."

Sheep models are also a key tool in Russell's work on Alzheimer's, because they have some natural genetic susceptibility to the condition. He's introducing a specific gene mutation – one seen in a well-studied population of humans – into his animal models. As a result, Russell can directly compare his results to those from the large-scale human study. "While we can't necessarily contribute to population studies," says Russell, "Our sheep model is an additional tool to understand what's going on with the pathology."

More than that, Russell's sheep could offer a valuable platform on which to test potential therapies for Alzheimer's before going into human clinical trials. He's collaborating with a group at the University of Gothenburg who look for biomarkers – such as the amyloid-precursor protein – in cerebrospinal fluid (CSF). "Our expectation is that in sheep, we'll see changes very early on in the disease's progression," he explains. "So, when testing how effective drug compounds are on those biomarkers, we might not need to look at the brain at all. CSF is a lot easier to access, so it could be a game-changer."

6.

Training tomorrow's leaders

The future of New Zealand neuroscience rests on the next generation of researchers and clinicians. And their success rests in turn on us – on our ability to train and to nurture them, and to prepare them for the challenges that will inevitably lie ahead. Our broad development goal is simple: to deliver innovative transdisciplinary training that will propel our Early Career Researchers (ECRs) into rewarding careers in the global research system.

In 2018, BRNZ welcomed seven directly-funded PhD students to the fold; Adrian Martinez-Ruiz (University of Auckland), Blake Highet (University of Auckland), Alehandrea Manuel (University of Auckland), Oluwatobi Eboda (University of Otago), Sophie Mathiesen (University of Otago), Justine Camp (University of Otago), and Usman Ghani (AUT). They will join an expanding network of 181 junior neuroscientists involved in BRNZ's research programme across the country.

Perhaps just as important as PhD training, is the support BRNZ provides our ECRs after they've completed their PhD. From funding postdoctoral research and travel, to help with grant writing, getting published, Māori cultural competency, forming collaborations, and gaining exposure to the clinical setting, BRNZ ECRs benefit from an extensive range of training opportunities afforded by the CoRE.

ECR Workshop
February 2018

When BRNZ held its first Early Career Researchers Workshop, our goal was to empower emerging researchers to undertake collaborative, impactful science by providing learning experiences well beyond the traditional lab setting. Each year, we expose our ECRs to a range of viewpoints from the social sciences, to government and policy, medicine and neuropsychological clinical practice, science communication, and from people and their families living with neurological disorders.

In 2018, BRNZ's Early Career Researcher Workshop was no different. Held at the Heritage Hotel in Auckland in February, the line-up of speakers was impressive. BRNZ heavyweights, including Co-Directors Profs. Peter Thorne and Cliff Abraham, Associate Director Prof. John Reynolds and Māori strategy leader Dr Hinemoa Elder were joined by 2017 L'Oreal-UNESCO International Rising Talent Award recipient, Associate Prof. Muireann Irish, equity specialist Trudie McNaughton, and leading neurologist Dr Peter Bergin. All 65 ECRs from across the CoRE were captivated by Muireann's talk on the foundations of memory and imagination, where she explained how humans remember the past and imagine the future, and how these capacities are disrupted in dementia. Muireann balances her love of science with raising her four-year-old son, introducing lesson #2 to our ECRs – how to 'work smart' rather than long hours. Other take home lessons ranged from how to achieve diversity in science, to how to build a collaborative team, and how to organise and share research data to achieve the best results.

In a first this year, Associate Prof. Yiwen Zheng led a group project development competition. The competition was an opportunity for ECRs to gain first-hand experience developing a research project from a multidisciplinary perspective, utilising the unique skills and knowledge each individual team member brought to the party. Each group was invited to pitch their proposal to a panel of BRNZ judges, who revelled in probing the pitches before awarding a prize to the winning team.

Leaving on a jet plane

BRNZ started its Young Ambassadors travel programme in 2016 to help budding New Zealand neuroscientists establish themselves in research. Since then, the programme has gone from strength to strength and in 2018 we were proud to support 32 ECRs in attending conferences and training courses across the globe. In the scientific community, a boarding pass represents much more than choice between the window and the aisle, it's an opportunity to meet the world's best researchers, to learn vital skills and techniques, and to gain experience presenting their research to a critical audience. For Otago-based Postdoctoral Fellow, Dr Shane Ohline, BRNZ support made it possible to accept a place at the highly prestigious Australian Course in Advanced Neuroscience (ACAN), where she gained a deep understanding of some of the most advanced techniques in neuroscience today. Because of the hands-on nature of the course, Shane also learned to successfully carry out the experiments outlined in the course lectures. After ACAN, Shane was awarded a career-defining Neurological Foundation of New Zealand grant, which she puts down – at least in part – to the fact she was trained in all the relevant techniques – "It was a win-win experience, and BRNZ helped to make it happen!"

Get up, stand up

While high impact research is increasingly a team endeavour, the most successful scientific collaborations have one important thing in common – effective leaders.

At BRNZ, opportunities for leadership development commence through membership of our Early Career Advisory Group (ECAG). This group of ten researchers provides advice and ideas for how we can best serve our CoRE ECRs, and plan and execute our yearly ECR workshops. ECAG are consulted internally from the Directorate regarding the functioning of the CoRE from the ECR perspective, and externally regarding how best to shape the research environment in New Zealand for the neuroscience leaders of tomorrow. In a pathway to leadership within the CoRE, ECAG members are frequently invited to transition to a Theme leadership group, with a view to eventual selection onto the CoRE Directorate and a more senior role.

In 2018 BRNZ piloted a dedicated Leadership Workshop, an intense weekend of activities for eight mid-career researchers across the CoRE, championed by an international facilitator. After earlier one-on-one planning meetings between the facilitator and delegates, the weekend symposium invited the delegates to consider what kind of leader they are and would like to be, and provided them with a number of tools by which to shape their leadership style towards that endpoint. The weekend was a resounding success, and the first tranche of delegates have now formed a cohort that will continue to work together to support the mutual growth of leadership skills within BRNZ, and the New Zealand science community.

Sophie Mathiesen

Trialling a new treatment for Alzheimer's disease

"I can't really remember a time that I wasn't interested in science," Sophie Mathiesen (Ngāpuhi) says. "My dad has a background in engineering and mum in chemistry, so they were always keen to help with the elaborate projects I designed." In high school, Sophie developed a strong interest in biology, which led her to take up a neuroscience degree at the University of Otago. She also picked up psychology as a second major because she enjoyed having a more comprehensive understanding of the brain at both a physiological and cognitive level.

Sophie first started working on Alzheimer's in an undergraduate project: "I'd developed a fascination with the pathology of Alzheimer's disease from some earlier classes, so I decided to take on an Alzheimer's-related project in Prof. Cliff Abraham's lab." She investigated potential therapeutic proteins and how they change the electrical activity of the brain. And, she adds, "Cliff has been stuck with me since!"

Sophie's PhD project, supervised by Cliff and Associate Prof. Stephanie Hughes, is trialling a new therapeutic approach for treating Alzheimer's disease. The treatment uses gene therapy, a technology which changes the genetics of the brain cells by delivering a gene of interest to the brain by using a modified virus called a viral vector. The gene that is packaged into the viral vector will help the cells to break down proteins that they no longer need. "It is thought that Alzheimer's disease is caused by a build-up of such proteins, so I hope that the cells will instead be able to break them down quickly before the cells are damaged," Sophie says.

Using gene therapy for treating Alzheimer's disease has two advantages, she explains: "Therapeutics can be administered non-invasively, for example through an intravenous injection, and achieve a long-lasting effect that is widespread throughout the whole brain." However, before treatments can be trialled in humans, they have to undergo a rigorous testing process in animals. Sophie is trialling her treatment in a well-characterised mouse model of Alzheimer's disease, which mimics the human disease. The hope is that one day it will be translated to a treatment for humans.

BRNZ is the perfect place for Sophie to do this kind of research. "I am mentored by some of the top neurological disease researchers in the country, I get valuable opportunities to collaborate with other researchers, and I am surrounded by a strong network of like-minded early career researchers," she says. Through BRNZ, she has also been able to communicate her research to the wider public, including Māori communities, which as she points out, "provide a unique perspective on the sometimes sterile world of basic science research."

Sophie hails from Ngāpuhi and is in the midst of discovering her whakapapa. She has been studying te reo Māori and is a tutor at the Māori centre Te Huka Mātauraka, where she provides academic and social support for Māori students. Within BRNZ, she is part of a network of Māori researchers, who hold wānanga throughout the year. Sophie has found her place within BRNZ – and she also knows where she would like to be in the future. "I love teaching, so I would like to pursue a lectureship position," she says. "And I definitely want to stay in neuroscience research – this is my home."

"I am mentored by some of the top neurological disease researchers in the country, I get valuable opportunities to collaborate with other researchers, and I am surrounded by a strong network of like-minded early career researchers."

SOPHIE MATHIESEN

7.

Working with Māori

Ehara taku toa i te toa takitahi, engari he toa takitini.

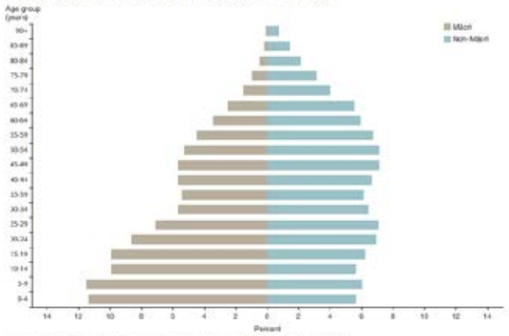
Success is not the work of one but the work of many.

New Zealand's Māori population is much younger overall than the general population, and it is also ageing. In fact, the next 20 years will see the proportion and the numbers of Māori aged 65 plus more than double. In 2038, Māori adults over 65 will make up almost 12% of the Māori population, compared to just over 5% in 2013. And while there have been some health gains for older Māori in recent years, significant disparity remains between the health status of older Māori and non-Māori New Zealanders.

That Māori are growing as a proportion of the older population and continue to experience inequalities in health – notably as a result of stroke and cardiovascular disease – is a key concern behind BRNZ's drive to improve Māori health and wellbeing in later-life.

In the past twelve months, BRNZ has been working on many fronts to identify and address barriers to Māori brain health. We have invested more in Māori-specific research that is led by Māori and that relies heavily on the involvement of Māori communities. We have increased our Māori workforce, and seen unprecedented uptake in applications for our Māori PhD scholarships, Master's scholarships, summer internships, and the Brain Bee Challenge. And, importantly, we have continued to strengthen our partnerships with Māori communities to improve our understanding of tikanga practices, and to help us translate our research findings into tangible benefits for Māori communities across New Zealand. While we still have a long way to go, we are proud to have come so far in just a few short years.

Figure 4: New Zealand population, 2015, Māori and non-Māori, by age



Source: Statistics New Zealand – Māori ethnic group population by age and sex at 2015

A talented Māori workforce

A key priority for BRNZ is the development of a thriving Māori neuroscience and health professional workforce. Greater numbers of Māori researchers and clinicians are essential to improving the approach to, and thinking around the assessment, treatment, and rehabilitation of older Māori, and their access to formal health services.

In 2018 BRNZ's burgeoning Māori research workforce continued to grow with the award of five Summer Research Scholarships and two inaugural Master's Scholarships to up-and-coming Māori researchers. 2018 also saw clinical psychologist Dr Julie Wharewera Mika (Ngāti Awa, Ngāi Tuhoe) commence her Eru Thompson Postdoctoral Fellowship, working with Dr Makarena Dudley (Te Rarawa, Te Aupouri, Ngāti Kahu) to explore clinical practices and therapeutic pathways for Māori living with neurological disease. We were also proud to welcome Māori PhD scholarship recipients Sophie Mathiesen (Ngāpuhi) and Justine Camp (Kāi Tahu, Kāti Mamoe, Waitaha), who join audiologist Alehandrea Manuel, in pursuit of their doctorates through BRNZ.

Takarangi Cultural Competency

Ma whero ma pango ka oti ai te mahi.

With red and black the work will be complete.

Cultural misunderstandings between health professional and patient, clinician bias, and the fragmentation New Zealand's health system are often cited as barriers for Māori to access and receive appropriate health care. Given this, and our need to partner effectively with Māori through the research process, a logical step for BRNZ in 2018 was to seek to educate our researchers to be more aware of cultural differences and more responsive to Māori cultural needs.

In June 2018, four BRNZ investigators took part in a cultural competency programme at Piritahi Marae alongside members of the Faculty of Child and Adolescent Psychiatry from the University of Auckland. The programme, called Takarangi Cultural Competency, is well-known in health services in New Zealand and provides a yardstick against which researchers and clinicians can measure their professional capacity, capability, and personal competency, to work with Māori. Delivered by Whaea Moe Milne (ONZM) and whānau, the programme is aimed at helping clinicians and researchers build competency in research that is meaningful for Māori health advancement. BRNZ is expanding its Takarangi Cultural Competency training in 2019, to facilitate the delivery of culturally competent research and health care by the BRNZ community.

***Left:** Māori PhD scholarship recipients Sophie Mathiesen and Justine Camp*

Prof. Suzanne Purdy

Te Tino Rangatiratanga o te Mate Ikura Roro: Empowering stroke survivors

"Our vision is to find a way to pilot this community initiative that has the ability to adapt to community needs. It could be an exemplar of something that could be facilitated in other rural places around the country, a model that could work for other neurological conditions as well."

PROF. SUZANNE PURDY

A recent study undertaken in Auckland concluded that while there is a moderate level of community stroke knowledge overall, this varies by ethnicity, and stroke awareness levels amongst Māori are particularly low. With the Māori population living longer, and thus increasingly suffering from neurological conditions, we need health services and interventions that recognise the unique needs of this community.

In previous research that Dr Karen Brewer (Whakatōhea – Ngai Tamahaua, Ngaiterangi – Tauwhao) had done in Ōpōtiki in the Bay of Plenty, she found that for many Māori, conventional healthcare simply does not work – partly because it is hard to access, but mostly because the services offered are not what Māori need. She also recognised that there was an incredible expertise in the community and a determination to take matters into their own hands.

The idea for the research project "Te Tino Rangatiratanga o te Mate Ikura Roro" came from one of Karen's research participants. "You know, I as a stroke survivor would like to help other people recently diagnosed as stroke survivors through my own journey," he said. "So make it happen!" The ultimate aim of the project was to develop a community-led peer support system for Māori who have suffered a stroke and to enable Māori to claim tino rangatiratanga over their own lives.

The project is firmly grounded in te Ao Māori: It is community-led and the entire research team is Māori. Prof. Suzanne Purdy (Te Rarawa) is lead investigator, while Te Whaawhai Taki (Whakatōhea – Ngāti Patumoana) carries out the majority of the research for her Master's degree at Te Whare Wānanga o Awanuiārangi. She is supervised by Suzanne, Karen (University of Auckland) and Prof. Virginia Warriner (Ngāti Whātua, Ngāti Porou) from Te Whare Wānanga o Awanuiārangi, making this project a multi-institutional partnership. They have also formed a Hunga Akoranga Mātauranga, a group that advises on academic aspects, and a Kāhui Mātauranga Māori, who ensure that the research follows tikanga Māori.

After receiving funding from BRNZ, Whaawhai took the topic to the community by attending hui, taking speaking opportunities, and engaging with Whakatōhea and surrounding iwi (Ngāti Awa, Ngāi Tāhoe, Ngāi Tai, Te Whānau-ā-Apanui). As Māori have historically suffered from being misinterpreted through research, it took a while for trust to be formed. But Whaawhai kept showing up and finally, work could begin. The team developed a questionnaire targeted at stroke survivors, their whānau, and health providers, to find out what was locally known about stroke. Initially, the people were not happy. "You're asking the wrong things," they said. "You're not asking the things we want to know." So the researchers amended the survey to reflect this feedback and to ask questions in a way that was acceptable to the community.

Above: *Dr Karen Brewer, Prof. Suzanne Purdy and Te Whaawhai Taki amongst the local community at Ōpape Marae near Ōpōtiki.*

The results showed a need for stroke education and for funding to develop resources. In a way, the answers are there already – the people know what they need. "This is where te tino rangatiratanga comes in," Karen says. "We can do it ourselves. We know what's best for us, we have the knowledge, the skills. We just don't have the resources to do it." The researchers concluded that they need a place in Ōpōtiki, a 'home' for stroke survivors and their whānau, independent from other providers. They want to create a tikanga Māori based intervention programme designed by and for stroke survivors and their whānau, and employ stroke survivors and their whānau to deliver it. Further, developing an education plan is imperative, Whaawhai says: "Māori are renowned orators – we need to develop this skill and put our own people into the community to talk about symptoms."

A lot of work lies ahead, but the community and the research team are eager to get something off the ground as soon as possible. "Our vision is to find a way to pilot this community initiative that has the ability to adapt to community needs," Suzanne says. "It could be an exemplar of something that could be facilitated in other rural places around the country, a model that could work for other neurological conditions as well."

Funding Māori-focused research

Research specifically for Māori benefit is best done by and with Māori, and for that we not only need a thriving Māori workforce but meaningful Māori-led studies aimed at improving Māori brain health. That is why we set up a Māori-specific research fund, to help Māori investigators conduct research projects out in the community, and with Māori, where it matters most.

To date, BRNZ has invested over $2 million in Māori-specific research led primarily by Māori investigators, and involving Māori community members in every step of the research process. And while the projects are widely varied, they all share the long-term aims of supporting self-sufficiency and Māori self-determination. Here is a snapshot of the exciting Māori-focussed research we have underway:

Understanding what mauri ora means for Māori in the context of the ageing brain

Dr Anne-Marie Jackson (Ngāti Whātua, Ngāti Kahu, Te Roroa) is working with Chanel Phillips to investigate what mauri ora (flourishing wellness) means for Māori in the context of the ageing brain. Starting with a desktop literature review to examine mātauranga (Māori knowledge) of the brain and what Māori consider mauri ora to be, Dr Jackson will also survey BRNZ members to garner their understandings of mauri ora.

Supporting Māori stroke survivors

Prof. Suzanne Purdy (Te Rarawa) is leading a team of Māori researchers who are developing a community peer support system for Māori with stroke. The two-year study builds on previous postdoctoral research that revealed Māori stroke survivors are keen to give back to their community and share their expertise to support fellow Māori stroke survivors, enabling them to claim tino rangatiratanga over their own lives.

Cognitive Stimulation Therapy for Māori

Dr Gary Cheung and Dr Makarena Dudley (Te Rarawa, Te Aupouri, Ngāti Kahu) are adapting cognitive stimulation therapy (CST) for Māori and Pasifika people with mild to moderate dementia. Once adapted, they will be able to train CST facilitators to deliver an evidence -based treatment to Māori with dementia. The researchers hope that the availability of CST will encourage Māori people to seek help for their cognitive impairment and promote early diagnosis of dementia, leading to better support for Māori and their whanau.

Māori perspectives of neurosurgery and brain stimulation for treating neurological diseases

Dr Louise Parr-Brownlie (Ngāti Maniapoto, Ngāti Pikiao) and Justine Camp (Kāi Tahu, Kāti Mamoe, Waitaha) are working with kaumātua from Puketeraki marae to learn Māori community perspectives about neurosurgery and treatments of neurological conditions and acute brain trauma. Louise and her team hope that the results of this study will support the development of resources specifically for Māori patients being considered for invasive treatments. By working at the biomedical science and mātauranga interface, they also hope that more clinicians will become aware of the full range of care and support Māori patients may need to get well and stay well.

Improving hearing, cognition, and audiology services for Māori

Māori PhD student Alehandrea Manuel (Ngāti Porou) is working to understand Māori worldviews on hearing, cognition, and current hearing health care services, to determine how to improve hearing aid service delivery for Māori. Alehandrea's research, supervised by Associate Prof. Grant Searchfield, will have a significant impact on the way audiology services are delivered for Māori and older New Zealanders within the next five to ten years.

Māori resources to increase awareness of dementia

Prof. Ngaire Kerse and her team have been working with Te Puna Ora o Mataatua, a Māori health organisation in the Bay of Plenty to develop and share dementia education resources that are tailored to Māori. Tailoring information in response to patient-specific health care barriers supports health literacy. Ngaire's project will enhance health providers' ability to provide culturally responsive dementia information and services to Māori patients and their whānau.

Te Kura Kaupapa Māori o Hoani Waititi and Puketeraki marae

Building close relationships with Māori is the basis of working well together, ultimately leading to good communication and Māori-centred research and clinical practices.

BRNZ has two sites of Māori community relationship-building wānanga local to our researchers: in Auckland, Te Kura Kaupapa Māori o Hoani Waititi Marae and in Dunedin, Puketeraki marae. Te Kura Kaupapa Māori o Hoani Waititi is a total immersion school in West Auckland with a reputation for excellence in Kapa haka and te reo Māori. We have now had three wānanga with the kura and on 5 November 2018, we visited the school to share our work with its teachers and students, and to open up conversations about science and possible career paths. In a similar vein, Puketeraki Marae hosted our South Island based researchers in early October for a noho marae, or overnight marae stay. The atmosphere there was warm and friendly, and provided an opportunity not just to strengthen our relationship with the marae, but also our cultural understanding of tikanga and te reo Māori. Through our partnerships with Hoani Waiti and Puketeraki marae are we are able to seek advice on how to engage effectively throughout the entire research process. We can test ideas, define issues and shape questions so our research is more significant for Māori communities. The lessons we have learnt from Hoani Waititi and Puketeraki whānau about what works are critical to ensuring improved outcomes for Māori, their whānau and communities.

***Above:** BRNZ members volunteer and plant native trees during the wānanga at Puketeraki Marae.*

Brain Bee and the Moko Foundation

For several years now, Associate Prof. Debbie Young has been at the helm of the New Zealand Brain Bee Challenge (NZBBC). The NZBBC is a competition for Year 11 high school students to learn about the brain and its functions, discover the latest discoveries in neuroscience research, and dispel misconceptions about neurological and mental illnesses.

Each year, participating students take part in Round 1 of the competition – a multi-choice neuroscience test held at their school. The top-scoring students from each island then go forward to either the North Island or South Island Brain Bee Challenge final, with the national champion winning the chance to duke it out across the Tasman in the International Brain Bee arena.

The NZBBC is a popular competition, and thanks to our partnership with the MOKO Foundation, it is proving even more so with kura from the Far North. In 2018, and with the Foundation's support, we recruited unprecedented numbers of Year 11 Māori students into the competition. Seventy-eight students from six schools across the region signed up to compete, more than twice the number of students we attracted from the region last year. BRNZ's aim in partnering with the MOKO Foundation to deliver this programme isn't just to expose kura students to neuroscience, but to give them an opportunity to explore university as an option, and to help make sure they succeed once they get there. Our partnership with the MOKO Foundation is two years old now, and while it may still be early days, we have no doubt that the success we experienced in 2018 is only a taste of what's to come.

THE MOKO foundation

***At right:** BRNZ's poster, "Te Reo Māori i Te Ao Rangahau Roro – The Māori Language in the World of Brain Research" designed by Ella Fischer for Māori Language Week 2018. It aims to encourage and promote the use of te Reo Māori in our daily mahi.*

TE REO MĀORI I TE AO RANGAHAU RORO

THE MĀORI LANGUAGE IN THE WORLD OF BRAIN RESEARCH

Ngā kupu roro – Brain terms

aho tuaiwi spinal chord
pūnaha ioio nervous system

mate roro brain damage
roro ikura stroke
mate wareware dementia
tuapaemahara Alzheimer's
mate paiori Parkinson's
mate o Huntington Huntington's disease
ikura haemorrhage

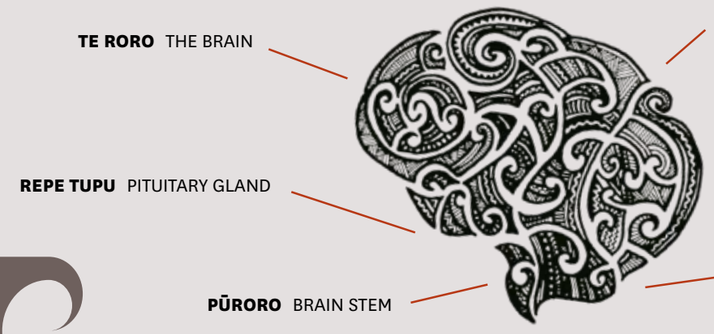
matawai roro brain scanner
whakaaro mīharo brain wave
whai roro brainy

Ngā kupu hauora – Health terms

whare haumanu clinic
hōhipera hospital
hāura patient
rongoā medicine
pūroi drug
oro ikeike ultrasound
hihi-X X-ray

hauora health, wellbeing
te taha hinengaro mental health
te taha tinana physical health
te taha wairua spiritual health/wellbeing
te taha whānau relationships and whānau health

hinengaro mind, awareness; cognition and emotion
mātauranga knowledge, education
manaakitanga care, support



Te Reo Māori mō te tari – Office phrases

Kia ora Hello (informal)
Tēnā koe/kōrua/koutou Hello (to 1/2/3+ people) (formal)
Ata mārie/Pō mārie Good morning/Good evening
Ko wai tō ingoa? What's your name?
Ko … tōku ingoa. My name is …
Nō hea koe? – No … ahau. Where are you from? – I'm from …
He pai te tūtaki ki a koe It's nice to meet you
Ngā mihi nui Best regards
Ngā mihi mahana ki a koe Warm greetings to you
Kia pai tō rā Have a good day
Ka kite (anō) See you soon

Āe/Kāo Yes/No
Sorry Aroha mai
Kia ora (rawa atu) (Many) thanks
Kei te pēhea koe? How are you?
Kei te pai/pukumahi/ngenge ahau. I am well/busy/tired.
Me hui tahi tāua/tātou. I would like to meet with you (all).
Me haere tāua/tātou ki te tina? Shall we (all) meet for lunch?
Ka pai! / Ka rawe! Good! / Awesome!

I te taiwhanga pūtaiao – In the lab

taiwhanga pūtaiao science lab
kaimātai pūtaiao scientist
rangahau research
kairangahau researcher

toto blood
pūtau cell
pūtautau tissue
karu whārahi microscope
mōhiti haumaru safety goggles
pae porowhita Petri dish
ngōine pipette
ngongo kirihou/kōata plastic/glass tube

Kei te haere koe ki hea? Where are you going?
Kei te haere ahau ki te taiwhanga pūtaiao. I'm going to the lab.
Kei hea te …? Where is the …?
Aua./Kāore au i te mōhio. I don't know.
Anei. Here it is.
Homai te …! Give me the …!

Justine Camp:

Navigating towards a whānau-based health model

"When you read my CV, I look a bit nuts," Justine Camp (Kāi Tahu, Kāti Mamoe, Waitaha) says. And indeed, the path that lead her to do a PhD at BRNZ is more diverse than most: Justine has taught te reo Māori since she was 16, studied social work, managed an art gallery and even opened a tattoo studio. At the same time, she also built her career as a Māori researcher, first completing a Masters looking at the impact of type 2 diabetes on whānau, and then working as a lecturer at the University of Otago for many years. Currently, Justine is a Research Fellow for the Better Start National Science Challenge, serves on a number of governance committees and is working on her PhD at BRNZ. "Finally," Justine says, "all my stars are aligning."

For her PhD project, supervised by Dr Anne-Marie Jackson, Justine is developing a Māori health model for whānau across the lifespan and across generations. The model is based on star compasses used by navigators to voyage the Pacific: They had to learn star constellations, watch how the stars move across the sky, and understand wave and wind patterns.

"I've created a health compass based on the same idea," Justine says. "If you do a lot of monitoring, you'll start to see patterns and get a picture of how things work."

Justine, her mother, daughter and grandson have all been trialling the model, as well as other intergenerational whānau groups. For three months, they recorded the different indicators in a diary – everything from the moon cycle, to water, sleep, daily activities, food, ... "In the first month, you're trying to work out what enhances and what diminishes your wellbeing," Justine explains. "And after about two weeks, you'll start to notice patterns and relationships. For example that during a full moon, you don't sleep well." There is also a focus on brain health within the model: Different indicators keep track of memory and activities that are good for the brain, such as practicing karakia or speaking a second language. One of the questions Justine tries to answer is how whānau understand the ageing brain, and the relationship between the ageing brain and wellbeing.

"I've created a health compass based on the same idea," Justine says. "If you do a lot of monitoring, you'll start to see patterns and get a picture of how things work."

Justine has developed her hauora (wellbeing) model in the context of Kāti Huirapa ki Puketeraki, Justine's hapū and a subtribe of Ngāi Tahu, and specifically within the framework of papakāika, a lived whānau community. For Justine, it is a chance to examine hauora in a way that is meaningful for her own community. She is not trying to change the current healthcare system (which does not benefit whānau), she says. Rather, she tries to develop a model that is empowering and focused on whānau improving their own health: "It's for you to take control of your health and wellbeing." And it seems to work: after the 25 participants finished the 3-month trial of Justine's hauora model, they have continued to use it and report being "mind-blown" by the experience.

With BRNZ's focus on kaupapa and mātauranga Māori, Justine's research is a valuable contribution to our Mātauranga research platform and the Centre as a whole. Moreover, Justine is facilitating the relationship between her papakāinga, BRNZ, and the wider neuroscience community. As one of our Māori community partners, the whānau of Kāti Huirapa ki Puketeraki plays a vital role in ensuring that our research is culturally responsive and meaningful for Māori. And having strong and committed kairangahau Māori (Maori researcher) like Justine will help us navigate these waters and stay on track.

8.

Going Global

“It takes the world to understand the brain”

Neurological disorders are now the leading cause of disability globally, and the second leading cause of deaths. In fact, one in three people today suffer from a neurological disorder worldwide. In the past 15 years, the people affected has increased from 20 percent to more than 30 percent.

In November 2018, BRNZ provided sponsorship for a one-day Global Burden of Disease Brain Summit to address the universal health issue of neurological disorders. Hosted by Prof. Valery Feigin at AUT, the summit saw international experts and officials from the Asia-Pacific region’s Ministries of Health and executives of international organisations including the World Health Organisation, World Stroke Organization, World Federation of Neurology, National Institutes for Health (USA) and the Global Burden of Disease study descend on Auckland to learn more about the global burden of neurological disease.

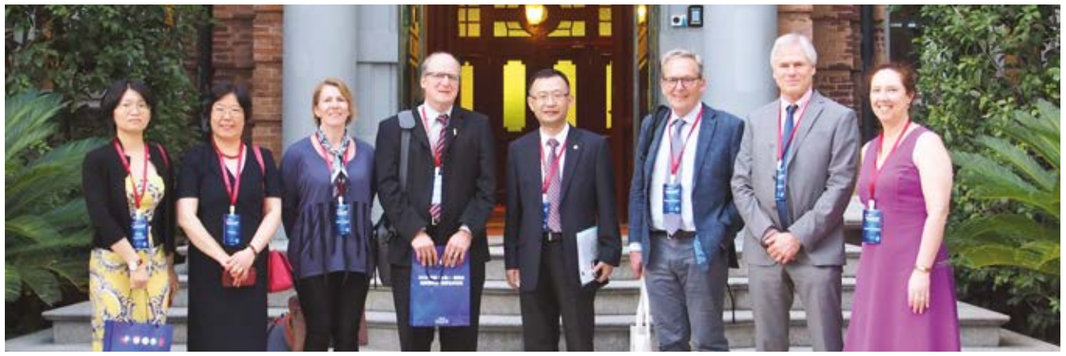
The alliance of international experts at the Global Burden of Disease Brain Summit is emblematic of what's been happening in the CoRE, as we represent New Zealand on the world stage and forge international partnerships to advance our mission. Understanding the ageing brain is a goal for the entire international neuroscience community, and with each year BRNZ’s research becomes increasingly multinational, demonstrating our international profile, connectedness, and collaboration.

Institutional partnerships and global strategies

In 2018, BRNZ continued to strengthen its collaborative relationship with research groups in Shanghai, particularly those associated with Huashan Hospital at Fudan University. BRNZ's relationship with China began in 2017 following reciprocal visits between Chinese and New Zealand neuroscientists and clinicians and the signing of a Memorandum of Understanding between BRNZ and the Huashan Hospital of Fudan University in Shanghai, and with the Shanghai Institute for Mental Health. To advance the collaboration in 2018, Huashan Hospital hosted a BRNZ delegation for a joint two-day symposium on neurological disorders. There, they joined a group of researchers from Huashan Hospital and the Shanghai Mental Health Centre to share information about their research and start discussions on possible joint projects. Areas of common interest included the human brain bank, Parkinson's disease longitudinal studies, and disease biomarkers and ideas for joint projects were developed during the meeting. BRNZ's work on stroke and sensory disorders also generated a lot of interest encouraging Shanghai researchers to look at increasing contacts in these areas as well. Our joint interests had already been instrumental in helping Huashan Hospital, Fudan University gain funding for a joint research laboratory, and this excellent symposium and the collegial discussions and interactions helped to solidify the relationship. BRNZ anticipates hosting the next meeting in New Zealand in 2019, possibly in association with the AWCBR conference in Queenstown.

International collaborative research projects

Researchers in BRNZ continue to build international collaborations in research areas supported by the CoRE. Dr Helen Murray, a BRNZ Postdoctoral Fellow (funded by the Health Education Trust) is working with Dr Alan Koretsky and Dr Leonardo Belluscio at the National Institute of Health, USA investigating the anatomical changes and a potential mechanism of degeneration in the Alzheimer's disease olfactory bulb. Dr Murray will undertake the histological imaging of human and mouse tissue, while the NIH group will carry out MRI analysis of human olfactory bulb and provide a mouse model of olfactory-driven beta-amyloid (Aβ) pathology. Associate Prof. Yiwen Zheng who is developing an important collaboration on metabolomics with the China Pharmaceutical University. The initial work focuses on identifying biomarkers of tinnitus using metabolomics and developing effective tinnitus treatment from traditional Chinese medicine. Associate Prof. Ping Liu is also developing collaborations in China, some of which have arisen from the Symposium in Shanghai. Associate Prof. Qunan Wang (from Anhui Medical University), will be visiting Dr Liu's laboratory for a year as a Visiting Fellow (supported by his institution) and a PhD student from Prof. Jijun Wang's laboratory (Shanghai Mental Health Centre) will also visit for a year (fully supported by her institution).



International meeting of Brain Initiatives

In October 2018, as a sign of our rising international profile, BRNZ Co-Directors, Profs. Cliff Abraham and Peter Thorne were invited to participate in a meeting of the International Brain Initiative, in Miyazaki, Japan. The symposium, a special one day meeting at the Systems, Man and Cybernetics (SMC) conference of the Institute of Electrical and Electronic Engineers (IEEE), involved representatives of country-specific brain initiatives from around the world. These included the EU Human Brain Project, NIH for the USA Brain Initiative, Korea, Japan, China, Poland and Russia, as well as the Australian Brain Alliance. Also represented were countries without a formal initiative, but with specific large scale investment in neuroscience, such as Canada and New Zealand (BRNZ).

As representatives for New Zealand, Profs. Abraham and Thorne described the larger aims of BRNZ from both research and community engagement perspectives, as well as the challenges and opportunities arising from meeting the needs of New Zealand's different ethnic groups in a culturally appropriate way. The latter fed in well to the presentation on neuroethics, which is an increasing challenge with the development, for example, of brain-machine interfaces and artificial intelligence.

The International Brain Initiative was established in recognition of the fact that the individual initiatives are engaged in an effort so large and complex, that no single one of them can succeed by working alone. The October meeting cemented further the initiatives' resolve to work together, and BRNZ is proud to be playing its part in the global effort to advance brain research.

***Left:** BRNZ delegation to Shanghai, from left: Dr Linya You, Associate Prof. Ping Liu, Prof. Denise Taylor, Prof. Cliff Abraham, Prof. Xiangjun Chen, Prof. Peter Thorne, Prof. Tim Anderson, Dr Louise Parr-Brownlie.*

Prof. Cliff Abraham: *President, Australasian Neuroscience Society*

We are delighted that Co-Director Prof. Cliff Abraham has now started his term as the President of the Australasian Neuroscience Society (ANS). Prof. Abraham is the first New Zealand representative to be President of ANS, a prestigious position acknowledging his standing as a leader in the field of neuroscience. He was also honoured by delivering the Lawrie Austin plenary lecture at the 2018 ANS Conference in Brisbane with a talk on "Metaplasticity: Cellular memories shaping future plasticity".

Dr Helen Murray *(Health Education Trust Fellow)*:

The best of both worlds

"From everything we know about Alzheimer's, it's not something that we'll be able to easily cure. What we need to do is prevent the disease from taking hold – which is why it's so important to figure out what is happening at the start."

DR HELEN MURRAY

Helen's love for science started when she was very young, a spark ignited by her dad. "We would sit down and he would teach me about molecules as a little six year old," Helen says. "I think that's my earliest memory of science." As a teenager, when her dad got sick and passed away, her interest turned to medical science – she needed to find out what was going on, what had gone wrong.

"I started biomedical science because I knew I didn't want to be a doctor – I wanted to be on the other side, figuring things out," she explains. During her degree, she attended one of Sir Richard Faull's lectures and couldn't help falling in love with neuroscience. Following this newfound passion led her to complete an Honours project with Sir Richard on a Huntington's sheep model and a PhD with Prof. Maurice Curtis looking at plasticity in human Alzheimer's disease brains.

Knowing that she wanted to keep doing research, Helen developed a proposal for a postdoctoral fellowship with the support of Maurice and Dr Leonardo Belluscio from the National Institutes of Health in the USA. In 2017, she was awarded the BRNZ Health Education Trust (HET) Alzheimer's Postdoctoral Fellowship, which is generously funded by the HET and provides three years of support for her work.

Helen's project is looking at one of the earliest changes in Alzheimer's disease – the loss of smell, which precedes the characteristic symptoms of memory loss by many years. "There is a really short pathway between the brain and the nose and thus, the environment," Helen explains. "The hypothesis is that environmental insults could induce toxic proteins to form in the cells of our nose that may access the brain through the olfactory system and then spread to deeper regions involved in memory function." Helen is looking at human olfactory bulbs with different grades of amyloid pathology and a transgenic mouse model that specifically produces beta-amyloid in the olfactory sensory neurons. She is also taking MRI scans of mouse and human olfactory tissue to perform high-resolution structural assessment of the human olfactory bulb – a worldwide first!

Ultimately, Helen's research will contribute to understanding how the disease actually starts and progresses. "From everything we know about Alzheimer's, it's not something that we'll be able to easily cure. What we need to do is prevent the disease from taking hold – which is why it's so important to figure out what is happening at the start."

The search for answers has brought Helen all the way to the National Institutes of Health (NIH) in Washington, DC, where she now works with the transgenic mice and high-field MRI in Dr Alan Koretsky's lab. There, she not only gets to use cutting-edge technology and benefit from intensive training, but she is also exposed to a different approach to research. "It's shaping the way I think about science," she says. "It's challenging me to ask bigger questions and it's made me realise that I'm capable of a lot more than I thought."

Helen spends around half of the year at the University of Auckland, and it's New Zealand where she wants to be in the long term. While this international project comes with challenges, she would not have it any other way: "It's the best of both worlds. I'm still immersed in the New Zealand research community, but I'm also at the NIH getting this amazing experience in an international lab. I'm growing my science and am able to bring it back to New Zealand."

Being part of BRNZ allows Helen to do exactly that. As a member of the Early Career Advisory Group, she helps to grow the research community within our research centre and New Zealand as a whole. "It's the perfect fit for what I was hoping to get out of this fellowship," she says. "It's nice to be able to jump in and give back a little bit."

9.

Public engagement

As a Centre of Research Excellence, conducting cutting-edge biomedical research keeps us busy most of the day. But just as important as the science we do, is the need to share it. From the scientific community, to the public more generally, sharing the results of our research gives BRNZ the vital opportunity to positively influence everything from people's attitudes and behaviours, to health services and policy, and ultimately, New Zealanders' quality of life.

In 2018, BRNZ invested even more into what was already a vibrant outreach programme. We strengthened ties with established partners Alzheimers New Zealand and the Neurological Foundation of New Zealand, and, with Alzheimers Disease International (ADI) at our side, we continued our drive to raise awareness of dementia both nationally and abroad. We registered another 80 schools for our Being Brainy programme, taking brain science into classrooms from Whangrei to Invercargill. We also boosted our fundraising activities, with the dedicated support and generosity of the New Zealand Dementia Research Trust and the Health Education Trust.

Brain Day & Brain Awareness Week

Brain Awareness Week and Brain Day are standing events in the BRNZ calendar. Led in New Zealand by the Neurological Foundation of New Zealand, BRNZ has been a proud supporter of this outreach campaign since we began in 2015. Both events give us the chance to strengthen our relationships with community groups, connect with the wider public, and share the latest research and benefits of neuroscience.

Brain Day in Auckland took place in July, with "The Amazing Brain: Research, Community and Care" as the headline act. BRNZ members contributed to panel discussions about living well with dementia, Traumatic Brain Injury, and brain and machine, while our ECRs ran fun experiments from the Being Brainy programme. Brain Day in Christchurch in March focused on "The Local Talent" and featured lectures by Prof. John Dalrymple-Alford and Dr Tracy Melzer, as well as kids activities and interactive displays. While in Dunedin, again in March, we partnered with the Brain Health Research Centre, the Neurological Foundation of New Zealand, and the Otago Museum to deliver five days of exciting lectures, discussions, and more.

BRNZ HITS THE BIG SCREEN

Every three seconds someone in the world develops dementia. **Today, it is estimated that there are nearly 44 million people living with Alzheimer's disease or a related form of dementia, and only around one in four people with the condition get diagnosed. So when we were invited to participate in an international film programme about dementia, we jumped at the opportunity to join forces with leading academics, research, and care organisations from across the globe to raise awareness of the national and global impact of this debilitating condition. For one day in May, our researchers practised their lines, took their places, and put on their best camera faces to share with the world the work they do.**

Produced by Alzheimer's Disease International (ADI) and ITN Productions, "Every Three Seconds" is a news and current affairs style programme that explores the risks, growth, and future response to dementia. It tells the stories of those who are impacted by the condition and those who work tirelessly to find novel ways to treat and prevent it, or to care for people with the condition.

BRNZ's segment showcases the different approaches we undertake to tackle dementia, including our partnership with the Māori community, our national network of clinics, our multicultural research approach, and the integration of experimental and clinical research to develop early biomarkers of Alzheimer's disease.

"We are excited to be part of this snapshot of the global effort to find ways to treat and prevent dementia and to care for those with the condition," says BRNZ Co-Director Prof. Peter Thorne. "It shows the international standing of the outstanding research contribution made by New Zealand neuroscientists and clinicians. Dementia is a major health issue that needs a concerted research effort."

"Every Three Seconds" premiered at the 33rd International Conference of ADI, one of the largest international conferences on dementia. It was then heavily promoted by ADI and participating organisations, sharing our combined efforts to tackle dementia with audiences from New Zealand all the way to Kenya, the USA, and further.

To see BRNZ's segment of the ADI film, visit our website at ***www.brainresearch.co.nz***

Being Brainy

Above: BRNZ Postdoctoral Fellow Brigid Ryan shares her passion for neuroscience

Igniting sparks in the young ones

"When I grow up, I want to be a scientist just like you are!" This must be one of the most rewarding things a scientist can hear from a young child. And this spark of curiosity is exactly what we try to ignite with our Being Brainy programme. Being Brainy is an educational resource for primary and intermediate schools developed by Prof. Bronwen Connor. Teachers can download ready-to-use teaching material and take their students on an exciting 8 week journey about the human brain. 2018 was an exciting year for Being Brainy, with over 200 schools now registered to deliver its lessons nationwide. Perhaps the biggest highlight of 2018 was a national drawing competition, where we asked children to do one thing: draw a picture of their brain. The competition was a big success and we were inundated with colourful and creative drawings showing just how alive little imaginations can be. We also sought feedback from teachers who have used the programme, which confirmed our hope: Being Brainy is a very valuable, practical and inspiring resource for students and teachers alike! One element they are particularly enthusiastic about are our scientist visits. Schools can request one of our neuroscientists to visit them, tell them secrets about the human brain, do fun experiments, and talk about life as a scientist. Most importantly, they answer any questions the students might have – and usually, there are quite a lot! The ultimate goal of Being Brainy is to spark children's interest in the human brain, in science, and in scientific enquiry, and it seems like our scientist visits achieve just that. They show the children that anyone can be a scientist – not just "old guys with weird glasses" – and they can too if they want to.

Fighting dementia, together

BRNZ has a big vision – lifelong brain health for all New Zealanders – and we know we cannot do it alone. This is why we work closely with the wider community to promote and improve brain health together. One of the organisations we partner with is Alzheimers New Zealand, one of the country's leading organisations advocating for people living with dementia.

Building on our efforts last year, we once again joined Alzheimers New Zealand to deliver a national series of dementia talks. From April to May 2018, BRNZ researchers visited Ryman Healthcare Retirement Villages in Auckland, Napier, Christchurch, and New Plymouth to raise awareness of dementia and the work BRNZ does to help fight the condition. The talks were exceptionally well received and presented an inspiring opportunity for our emerging researches to connect with communities.

Another great occasion for us to engage with community organisations, health care and dementia services professionals, and most importantly, the people affected by dementia, was the biennial Alzheimers New Zealand conference. BRNZ provided sponsorship for the 2018 edition, "Tackling Dementia: It's Everybody's Business", which was attended by over 300 people, with 30% of the delegates being people with dementia and their carers.

There was no escaping BRNZ, as our researchers were featured in many of the presentations and plenary sessions. Dr Gary Cheung gave an introduction and live demonstration of Cognitive Stimulation Therapy, while Dr Makarena Dudley held a highly anticipated speech about her project "Kaumātuatanga o te Roro: A Māori approach to the assessment and management of dementia." Conference visitors could also find out about the Dementia Prevention Research Clinics (DPRC) and the "Living with Dementia in Aotearoa" (LiDiA) study. This year, we felt especially honoured to be joined by Graeme Newton, a DPRC participant, and his wife Jay as our special guests. They have become true ambassadors of our Clinics and made sure there were always lively discussion going on at the BRNZ booth.

It is this direct link to the community that makes participation in this conference – and the collaboration with Alzheimers New Zealand – so valuable for us: We get the chance to connect with people who in one way or another are affected by the conditions we research, to hear their thoughts and needs, and to figure out what we can do to help. And with strong partners like Alzheimers New Zealand on our side, we feel confident pushing towards our goal of lifelong brain health for all New Zealanders.

Above: From left, Dr Susan Yates, Jane Govender, Ella Fischer and Christine Brennan share information on BRNZ's Dementia Prevention Research Clinics.

Above: Dr Gary Cheung introduces Cognitive Stimulation Therapy to conference attendees.

How common is dementia, really?

There are said to be more than 60,000 people living with dementia here in New Zealand. But did you know that this number is only an estimate, based on statistics from other countries? To date, there has never been a dedicated, nationally-representative study into the prevalence of dementia. This is a situation that BRNZ Principal Investigator, Dr Sarah Cullum, wants to change.

When she arrived here from the UK in 2016, Sarah worked as a Consultant in old age psychiatry at South Auckland's Middlemore Hospital. "One of the first things I noticed was that, in the memory service, we seemed to see Māori and Pasifika people at a younger age than NZ Europeans," she says. "On looking into it, I realised that there was hardly any epidemiological studies on dementia here – we had nothing that took account of New Zealand's unique demography."

Just a few months later, an academic post in the Department of Psychological Medicine was advertised at the University of Auckland. Sarah applied for it, was successful, and began developing the preparatory work to study dementia in different New Zealand communities.

Through this work she met other members of the BRNZ family – Prof. Ngaire Kerse, Māori neuropsychologist Dr Makarena Dudley (Te Rarawa, Te Aupouri, Ngāti Kahu), and Senior Lecturers Dr Gary Cheung and Dr Rita Krishnamurthi. "We all just clicked, really, especially on the need for cross-cultural, population-wide studies on dementia," Sarah says. "We started to develop the idea for a project, based around translating the 'gold standard' dementia assessment tool (the 10/66 protocol) for use in different communities and gradually the team is growing around us."

Their overall goal is ambitious; to measure the prevalence of dementia in people aged over 65, and the cost impact of dementia particularly on unpaid family carers, across all of NZ's major ethnic groups. The first step along that path is a large-scale feasibility study to refine their tools and procedures, and ensure they are fit-for-purpose. For this, they have received financial support from both BRNZ and the HRC, allowing the team to reach participants from six different communities – Samoan, Tongan, NZ European, Māori, Chinese, and Indian.

"Dementia is becoming a global public health priority, but for us to understand the scale of the issue here in New Zealand, we urgently need to have our own data." DR SARAH CULLUM

Central to this effort is the diverse and highly-experienced research team that has been assembled. "From the very beginning, we recognised that – in addition to the technical skills we all bring – if we were going to do something multi-cultural, then those cultures need to be represented at the very heart of the team," she says. So, joining Sarah, Margaret, Rita, Gary and Ngaire, are Dr Fiva Fa'alau – an expert in Pacific health and wellbeing – and Dr Etu Ma'u, a Tongan old age psychiatrist working in Waikato.

In the initial stages, the team worked with local NGOs providing services for the elderly, including Dementia Auckland, Shanti Niwas and Vaka Tautua, as well as Middlemore's memory clinic, but are now beginning to reach out to all of the communities. Sarah admits that this aspect of the project is not without its challenges, but she's confident that they'll achieve what they've set out to do, "We have a lot of cultural complexity to navigate, but thankfully, we have an exceptional team who bring with them an incredible depth of knowledge."

She continues, "Dementia is becoming a global public health priority, but for us to understand the scale of the issue here in New Zealand, we urgently need to have our own data. That's why the tools and knowledge that we're building are so important."

Members of the study team, from left: Dr Susan Yates, Dr Rita Krishnamurthi, Dr Sarah Cullum (Lead Investigator) and Adrian Martinez-Ruiz.

10.

The Dementia Prevention Research Clinics

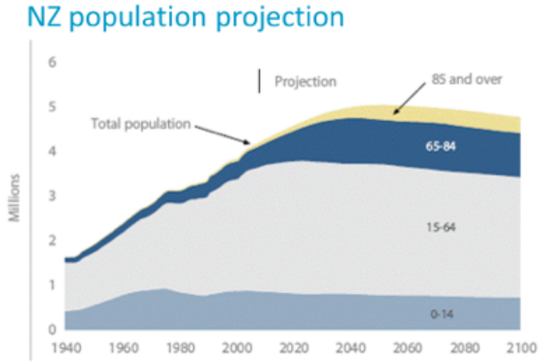
It takes a village

More than 60,000 people in New Zealand suffer from Alzheimer's disease (AD) or a related dementia and by 2050 that number is expected to triple. In fact, in the next 50 years, we'll see an epidemic of neurological diseases, such as Alzheimer's, as the world's population ages. Alzheimer's disease has no cure, and many believe that the best way to combat it is to prevent, rather than treat the condition. But preventing Alzheimer's isn't as easy as it might seem. Made up of a staggering 170 billion cells, the brain is the most complex organ in the human body. Combine this complexity with the changes and individual experiences that accumulate over a lifetime and the difficulty of identifying the specifics behind Alzheimer's becomes quite clear. And for those who've already received a life-changing diagnosis, drugs or therapies that slow the progression of the disease are urgently required.

This is where BRNZ's Dementia Prevention Research Clinics (DPRCs) come in. In 2015, BRNZ set out to establish a national network of research clinics to recruit 400 New Zealanders with mild cognitive impairment (MCI) or early AD and to follow them over the course of ten years. A long-term study, the DPRCs are a partnership between clinicians, District Health Boards, GPs, BRNZ researchers, and study members across three cities, who are all working together towards the same goals. The first is to try and identify factors that influence the development and progression of memory problems and dementia in New Zealanders. The second is to invite study members to participate in a range of other research projects to further our understanding of these conditions and the experience of individuals and their whānau members. Finally study participants will have the chance to take part in testing interventions and treatments to delay progression of MCI to dementia, and to slow the progression of early dementia.

The overall aim of the DPRCs is simple: to take our findings and to translate them into programmes, tools and potentially treatments that can be incorporated into the lives of the New Zealanders who need them, as soon as we possibly can.

2018 marks two years since our first Dementia Prevention Research Clinic opened its doors. Since then we have enrolled 158 individuals into the study across Auckland (145 participants), Dunedin (16) and Christchurch (18) and have 15 projects underway using samples or data from study participants, or which involve some participants in further studies. Several of these projects involve highly sophisticated MRI brain scans,



and are looking for early biomarkers that correlate with clinical change. These include subtle structural changes and calculation of "brain age" as a biomarker, changes in blood perfusion in the brain, changes in the blood-brain barrier, and functional MRI analyses that look at changes in the activity and connectivity of networks in the brain, which may provide early indications of who is at risk. This ability – to identify early biomarkers of Alzheimer's – will help us not only to diagnose the condition, but to monitor it over time, and to predict who is most likely to experience worsening of memory and functional difficulties, ultimately making it easier to beat.

Above: *Mr Bill Thompson, one of the first study participants recruited into the Dunedin DPRC.*

Above: *From left, Associate Prof. Lynette Tippett, Prof. Cliff Abraham, The New Zealand Minister of Health, Hon Dr David Clark, Dr Nick Cutfield (Dunedin DPRC Director) and Prof. Peter Thorne celebrate the official launch of the Dunedin Dementia Prevention Research Clinic, February 2018.*

Next year, in a first for the clinics, Prof. Denise Taylor and Prof. Paul Smith will start a pilot intervention trial looking at the rehabilitation of spatial navigation and spatial memory using GVS (galvanic vestibular stimulation) in study members with MCI. Spatial navigation is the ability to find our way around our environments. It involves a complex integration of cognitive abilities, balance, and walking, and is commonly affected in MCI. Research shows us that the vestibular system, or inner ear, with its rich connections to a part of the brain called the hippocampus, plays an important role in spatial navigation. The research team is investigating whether a small imperceptible electrical stimulation to the vestibular system combined with a balance rehabilitation programme will improve spatial navigation, balance, and walking ability in people with MCI. The electrical stimulation is set at an optimal level for each participant and applied via electrodes placed behind the ears. This electrical stimulation, called noisy galvanic vestibular stimulation (nGVS), aims to strengthen the neural signalling from the vestibular system to the hippocampus and improve spatial navigation, balance and walking ability. What's exciting about this is that it presents an early intervention that has the potential to reduce functional decline in people with MCI. In time, it could lead to the development of small, inexpensive, easy to use nGVS systems that people can use at home, linked with a home-based rehabilitation programme – not too dissimilar from wearing Bluetooth headphones as you go for a walk. If successful, Prof. Taylor's concept will not only make rehabilitation significantly cheaper, but also easier to access for those who live in remote areas, leading to improved patient outcomes and reduced costs of healthcare, both big ticks for the New Zealand health system.

National DPRC Director Associate Prof. Lynette Tippett says, **"We are grateful for the enthusiasm and willingness of the participants who will always be central to our research, who offer so much of themselves."**

The impressive progress to date of the DPRCs wouldn't have been possible without financial backing from the New Zealand Dementia Prevention Trust (NZDPT), the support of our research partners, and the unwavering commitment of

Fast facts:

MILD COGNITIVE IMPAIRMENT

- *Mild cognitive impairment (MCI) affects memory and thinking abilities, but does not significantly interfere with daily life.*
- *While MCI does not always lead to dementia, people with MCI are more likely to develop Alzheimer's disease or other dementias*
- *1 in 5 people with MCI will return to normal cognitive functioning for their age within a few years.*
- *It is estimated that between 15- 20% of people over 65 years of age have MCI*

our study participants. National DPRC Director Associate Prof. Lynette Tippett says, "We are grateful for the enthusiasm and willingness of the participants who will always be central to our research, who offer so much of themselves." The "so much" Associate Prof. Tippett is referring to include the annual in-depth clinical assessments our study participants undergo each year, where they undergo comprehensive tests of their memory and thinking abilities. They also provide blood samples, which is collected, processed into different blood fractions and stored in liquid nitrogen for future research. Every second year they also undergo MRI scans and beginning in 2019, PET imaging (positron emission tomography) as well, to detect the harmful clumps of amyloid-β that are associated with Alzheimer's disease. Given the time commitment and challenge of some of the procedures involved in being part of the DPRCs, you might reasonably ask why study members choose to volunteer. DPRC participants gain access to the best neurologists, geriatricians, psychiatrists, psychologists, research nurses, MRI experts and radiologists in the country, not to mention state-of-the-art facilities. Our staff are dedicated and caring, and we give participants extensive feedback on their condition, communicate with their GPs, and attempt to make the process one that is reciprocal, and equally beneficial. We include participants in the research journey and share with them our results. We place high value on manaakitanga – looking after participants. Beyond that, altruism is commonly the driving force, with many involved to help us find a cure; to help improve care and treatment; to improve quality and length of life; and to prevent the same thing happening to others.

BRNZ's Dementia Prevention Research Clinics are a first in New Zealand, providing vital information about Alzheimer's disease onset and risk factors in a local context, and with the potential to lead to significant discoveries, and the development of new interventions and therapies for our ageing population.

They say it takes a village to raise a child. The same could also be said of preventing or delaying Alzheimer's disease. The steadfast hard work of the DPRC teams, study participants, philanthropic donors, whānau members, research collaborators, and BRNZ's researchers all working together, is the essential ingredient to bringing success.

11.

Knowledge exchange

Each year, BRNZ invests significant time and effort to transfer our expertise, intellectual property, learning and skills to the scientific and non-academic communities. Be it through publications, patents, work with health professionals, graduates joining the workforce, lectures, events, or collaborative research, we actively look for new ways to connect with our stakeholders to increase the impact of our work. While examples of BRNZ's knowledge exchange activities are studded throughout this report, here we highlight a handful more with the potential to make a big difference.

"He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me."

THOMAS JEFFERSON

A problem shared is a problem solved

In 2018, BRNZ and the MedTech CoRE continued to work together, co-hosting our second annual "Brain and Technology" symposium to showcase research from both CoREs and to offer joint funding to back new ideas for technologies related to brain therapies and treatment, stemming from new inter-CoRE collaborations. This year's symposium featured a Dragon's Den competition designed to spark collaboration between BRNZ and MedTech researchers. The overarching question: How can new technologies enhance research into the ageing brain? We presented six clinical challenges and then left everyone to break into groups and come up with innovative and feasible solutions. What made the competition particularly exciting was that the combined skills and expertise in each group meant that each one could work on products that they could actually "move to market". The competition was a huge success, and resulted in three new collaborative BRNZ/Medtech co-funded projects that are now underway. One of these, titled "Te Ōranga o te Roro: App for Dementia Awareness and Prevention Through Risk reduction (ADAPT-R)", has seen Dr Makarena Dudley (BRNZ) and Marcus King (MedTech) and their colleagues unite to develop a prototype app that is tailored to Māori needs to increase awareness of risk factors of dementia.

With our complementary goals and research expertise, the Ageing Well National Science Challenge is another New Zealand research consortium that has fast become a close collaborator. Ageing Well's mission is to push back disability thresholds to enable all New Zealanders to reach their full potential through the life course, with particular reference to the latter years of life. In 2018 BRNZ and Ageing Well co-funded three research projects that stand to advance both consortia's research programmes. The first project, led by Prof. Pauline Norris, is exploring the needs of Pacific families affected by age-related cognitive impairment. The second, a study led by Dr Gary Cheung, will see Cognitive Stimulation Therapy adapted for Māori and Pasifika people with mild to moderate dementia. Lastly, BRNZ and Ageing Well awarded Dr Rita Krishnamurthi funding to investigate the long-term effectiveness of health and wellness coaching.

***Above:** BRNZ and MedTech researchers share the stage at the 2018 "Brain and Technology" symposium.*

Preventing stroke through coaching

Each year, stroke shortens the lives of millions of people across the globe – it is the second most common cause of death and disability worldwide. But according to BRNZ investigators, Dr Rita Krishnamurthi and MacDiarmid Medal winner, Prof. Valery Feigin, the overwhelming majority (up to 90%) of strokes are preventable.

"We know that the most effective way to prevent someone from having a stroke is to manage the modifiable risk factors, like blood pressure and diet," says Valery. "They're called 'modifiable' because it's possible to change them, largely through adjusting your lifestyle." Such management strategies are well-established, but as anyone who has ever made a New Year's resolution knows, lifestyle changes don't always stick. Rita and Valery felt that a more targeted approach like health wellness coaching could lead to longer-term benefits, but internationally, there was a lack of evidence-based research on such interventions.

This is why the AUT team set up a remarkable clinical trial called PreventS. It aims to determine if personalised coaching could be an effective tool for stroke prevention in people with an elevated risk of cardiovascular disease and stroke. The cohort of 320 includes Māori, Pasifika, New Zealand European and Asian participants. "The multi-ethnic nature of this trial is really important, because some of these communities have particularly elevated risk of stroke," says Rita. "For example, Māori and Pasifika tend to suffer stroke at a much earlier age than New Zealand Europeans, and we still don't understand all of the contributing factors."

In their trial, which was funded by the Ageing Well National Science Challenge (NSC), each participant was randomly assigned to one of two groups – they'd either receive 'usual care' (i.e. assessment only) or 15 sessions with a trained health wellness coach, over a period of nine months. For Valery, the key to keeping participants motivated is that, "...the goals are set by the person themselves. Everyone is different, so by working directly with a coach, they get the support that suits them." This motivational approach complements another aspect of Valery's work – the Stroke Riskometer™ app, which now has 160,000 users worldwide.

The promising results of the PreventS trial has led to further funding from BRNZ. "This additional support will allow us to revisit our participants three years after randomisation, so that we can explore the long-term effectiveness of health wellness coaching," says Valery. The involvement of BRNZ also offers the team a unique opportunity to increase the scope of the study. "International evidence suggests that people with very poor cardiovascular health have a higher risk of developing mild cognitive impairment," Rita explains. "So, under the guidance of Associate Prof. Lynette Tippett, we've added initial cognitive screening. If as a result of the screening, a patient wants to undergo a more extensive assessment and follow-up, we can connect them to Lynette and her team at the Dementia Prevention Research Clinics. It's a true collaboration."

Working with the health sector

BRNZ is committed to ensuring that New Zealand's health sector keeps up with the latest developments in ageing-brain research. By working with the health sector, our researchers and their work bring benefits to patients, to the community, and to society as a whole. What follows are but a few examples of how BRNZ's collaborative efforts in the health sector are leading to new advances in New Zealand health care.

PROF. ALAN BARBER

Neurological Foundation of New Zealand Prof. of Clinical Neurology Alan Barber was the New Zealand Principal Investigator for the EXTEND IA study, one of the five pivotal studies showing the benefit of a new clot retrieval procedure in acute ischemic stroke. Prof. Barber's team has shown that the procedure can save the lives of patients who get to hospital within the first six hours of having an ischaemic stroke (caused by a blood clot). The clot can be removed using a mesh-like retrieval device, freeing the clot from the brain. Prof. Barber has led the implementation of this procedure in New Zealand and already over 270 people have been treated at Auckland City Hospital. In 2018, the success of this procedure led to it being launched in hospitals in Wellington and Christchurch.

DR GARY CHEUNG

Dr Gary Cheung co-leads the translation and research of cognitive stimulation therapy (CST), an evidence-based psychosocial treatment for dementia, in New Zealand. The therapy has the potential to improve cognition, memory and thinking ability, language and how people express themselves, as well as their quality of life. With funding from Te Pou, Dementia Auckland and BRNZ, Dr Cheung has trained over 200 health professionals to provide CST across Australia and New Zealand. Dr Cheung is now working with BRNZ investigator Dr Makarena Dudley to adapt CST for the needs of Māori, to extend its impact even further.

PROF. NGAIRE KERSE

Prof. Ngaire Kerse regularly supports the ongoing professional development of healthcare professionals working in primary care, most recently through a Goodfellow Medtalk where she gave expert advice to New Zealand GPs about how to maximise the health of older patients. Topics Prof. Kerse covered included: what is important for ageing well; factors that may affect health outcomes as people age; and how to rationalise prescription medicines for older patients.

In the media

With such a large proportion of New Zealanders learning what they know about science through the media, featuring in newspapers, radio broadcasts and on TV is one of the most powerful ways to share our research, and increase its reach and potential impact. In 2018, BRNZ researchers and their work featured in national media on average almost three times a week, with articles and interviews potentially reaching tens of millions in New Zealand and overseas. Examples include:

- **Neurological Foundation of New Zealand Prof. of Clinical Neurology, Alan Barber**, featured heavily in the news including appearances on TV3 Newshub, Māori TV, and stuff.co.nz. The articles and interviews focused on clot retrieval, a novel procedure that is revolutionising stroke treatment in New Zealand.
- Several BRNZ researchers featured in 'The Curious Mind', a 4-episode TVNZ programme where Nigel Latta goes on a journey to explore the human brain. **Distinguished Prof. Sir Richard Faull, Prof. Cliff Abraham, Prof. John Reynolds, Dr Reece Roberts**, and even a participant of our Dementia Prevention Research Clinics appeared on the show.
- **Prof. John Reynolds'** work was the focus of a feature article in the New Zealand Herald, called "Groundbreaking device gives hope to people with Parkinson's."
- **Dame Margaret Brimble** was part of New Zealand Herald's 'Trailblazers', a series that presents 125 New Zealand women who have changed the world.
- **Dr Makarena Dudley** and her work on developing a Māori approach to the treatment and management of dementia featured in the news several times. It was also the focus of an episode of the TVNZ Attitude programme.
- **Dr Anne-Marie Jackson** was part of a news feature in Nature, one of the world's leading science journals. The article published in June 2018 was called, "These labs are remarkably diverse – here's why they're winning at science."
- **Prof. Valery Feigin** featured heavily in national and international news, commenting on new data from the Global Burden of Disease study and discussing the state of neurological care in New Zealand.
- In June, **Prof. Maurice Curtis and Dr Brigid Ryan** gave interviews to the New Zealand Herald and TVNZ One News, discussing the launch of the world's largest multi-generational study of frontotemporal dementia.
- **Prof. Grant Searchfield's** research on Tinnitus featured regularly in the New Zealand Media including Seven Sharp (TV NZ) – "The disorder which makes certain sounds unbearable for sufferers" and Radio New Zealand – "Tinnitus: why you get that ringing in your ears", "Can better hearing aids help reduce cognitive decline?".
- **Prof. Lianna Machado's** research was covered multiple times by the Otago Daily Times (ODT), notably in a feature titled "The Weekend Mix on successful cognitive ageing, keeping your marbles: The science behind good brain health".
- **Prof. Ngaire Kerse** was interviewed by Radio New Zealand on her LiLACs study, which aims to increase knowledge on the ageing population to improve the health and wellbeing of New Zealanders of advanced age.
- In February, the Otago Daily Times published an article about the launch of the Dunedin Dementia Prevention Research Clinic under lead PI, **Dr Nick Cutfield**.

Awards and accolades

- **Distinguished Prof. Dame Margaret Brimble** was elected a Fellow of the Royal Society of London, making her the only female New Zealand-based scientist to join the ranks of Sir Isaac Newton and Sir Charles Darwin.

- **Prof. Bronwen Connor** was appointed as a member of the New Zealand Order of Merit in the 2018 Queen's Birthday Honours. She received this honour for her pioneering work on the treatment of neurological disorders and for her educational outreach programme.

- **Prof. Warren Tate** was jointly awarded (with Prof. John Montgomery) the 2018 Marsden Medal by the New Zealand Association of Scientists. He received the medal for a lifetime of outstanding service to science, his discoveries in molecular biology and human disease, and his collaborative research.

- In recognition of his outstanding work to stroke prevention, **Prof. Valery Feigin** was awarded the 2018 Excellence in Stroke Award, presented by the Stroke Society of Australia.

- In May 2018, **Dr Hinemoa Elder** was awarded the Royal Australian and New Zealand College of Psychiatrists' Mark Sheldon Prize.

- **Prof. Ngaire Kerse** was awarded the Charles-Bridges Webb Medal for her contribution to primary care research, and particularly for her outstanding research in the care of the elderly.

- **Dr Tracy Melzer** was awarded the University of Otago Early Career Award for Distinction in Research.

- **Associate Prof. Johanna Montgomery** was awarded the Physiological Society of New Zealand Excellence in Research Award.

- **Dr Moana Theodore** was elected a member of the Royal Society Te Apārangi Council. Moana's research focuses on areas of importance to Te Apārangi, including issues of diversity and equity, building positive Māori futures, supporting Pacific success, and pathways to ageing well. 2018 also saw Dr Theodore receive the HRC New Zealand Māori Health Emerging Leader Fellowship.

- **Prof. Richie Poulton** was named in the top 1% most-cited researchers in science in the world. Prof. Poulton, Director of the University of Otago's Dunedin Multidisciplinary Health and Development Study (also known as the Dunedin Study), is one of only four New Zealand researchers named in the top 1% section of the 2014 Thomson Reuters Highly Cited Researchers List.

Service

Brain Research New Zealand's researchers are eminent members of the international science community and hold leadership and research advisory positions in many professional bodies, Non-Government Organisations and New Zealand-based charities. In 2018 BRNZ researchers continued to dedicate their time and considerable expertise to the following national and international entities:

National

- Age Concern Otago
- Alzheimer's Association Otago
- Alzheimer's Auckland Charitable Trust
- Alzheimer's Foundation (Auckland)
- Alzheimers New Zealand Charitable Trust
- Auckland Medical Research Foundation
- Community Care Trust Otago
- Deafness Research Foundation
- Health Research Council, Biomedical Research Committee
- Hearing Research Foundation New Zealand
- High Performance Sport New Zealand
- Huntington's Disease Association (Auckland)
- IDEA Services, Otago
- Ministry of Health National Stroke Network Leadership Group
- Motor Neurone Disease Association of New Zealand (Inc.)
- Multiple Sclerosis Otago
- National Centre for Lifecourse Research
- National DBS (Deep Brain Stimulation) Committee
- National Foundation for the Deaf
- National Stroke Leadership Group
- Neurological Foundation of New Zealand
- Neurology Association of New Zealand
- Neuromuscular Research Foundation Trust
- New Zealand Psychologist Board
- New Zealand Rehabilitation Association
- Ngā Kete Mātauranga Pounamu Charitable Trust, Invercargill
- Pacific Island Advisory and Cultural Trust, Invercargill
- Pacific Radiology Research and Education Trust
- Pacific Trust, Dunedin
- Parkinson's Association Otago
- Stroke Foundation of New Zealand
- Stroke Foundation Otago
- Te Pou o te Whakaaro Nui, New Zealand's National Centre of Mental Health Research and Workforce Development, Member
- The Physiological Society of New Zealand
- The Royal Society of New Zealand

International

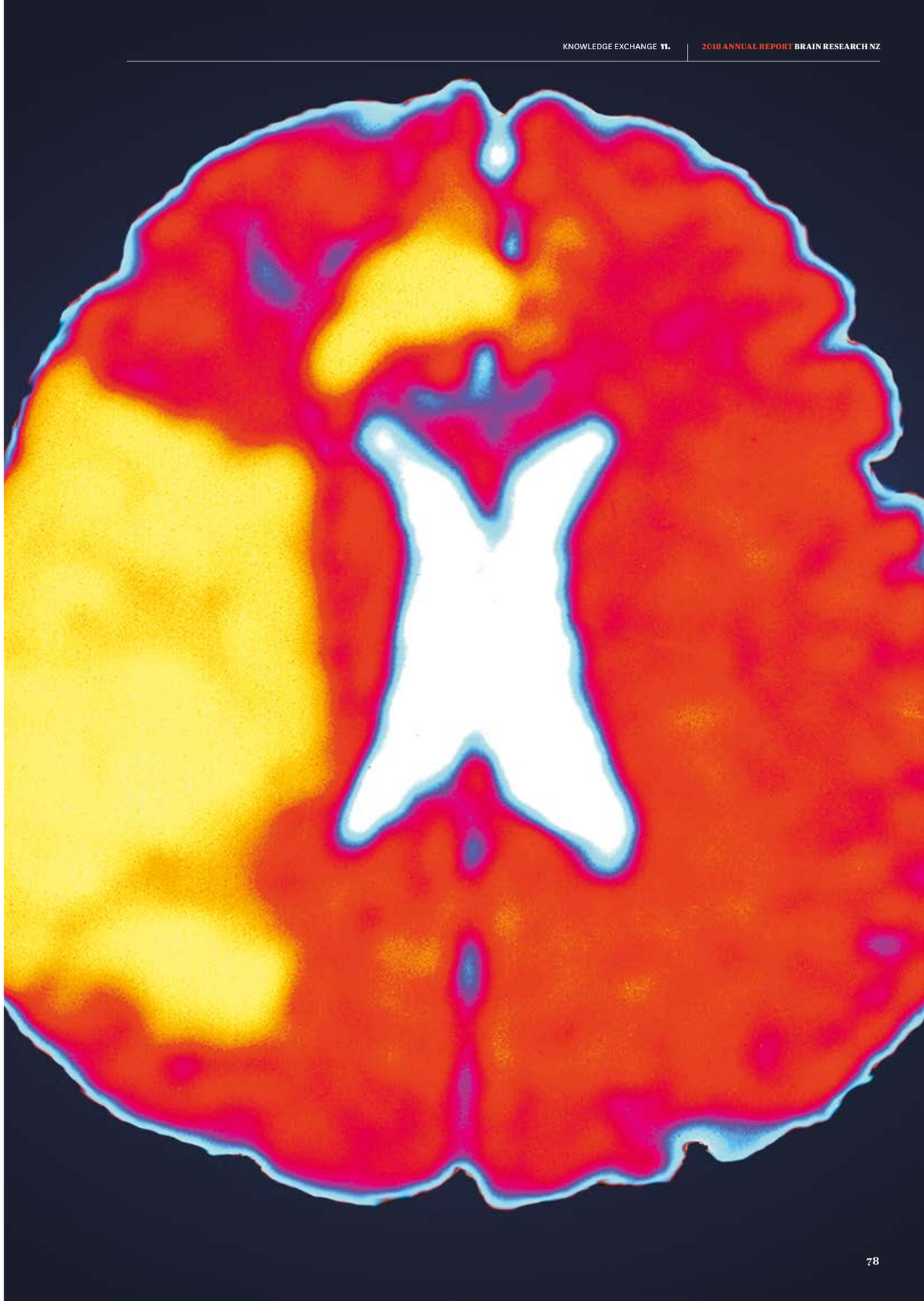
- Alzheimer's Disease International medical and scientific Advisory Panel
- American Academy of Neurology
- American Journal of Physiology – Cell Physiology
- American Society of NeuroRehabilitation
- American Tinnitus Association
- Australasian Neuroscience Society
- Australia and New Zealand Association of Public Health
- Australia and New Zealand Falls Prevention Society
- Australian and New Zealand Association of Neurologists
- Biomedical Engineering Society (BMES)
- European Federation of Neurological Societie
- Human Frontiers Science Programme Organisation
- International Frontier Sciences Programme, New Zealand Representative
- International Institute for Brain Health
- International Society of Vestibular Physiologists
- International Society to Advance Alzheimer's Research and Treatment (ISTAART) community, Alzheimer's Association (USA)
- International Upper Limb Stroke Rehabilitation Group
- National Health and Medical Research Council, Australia
- National Science Foundation, USA
- National Stroke Foundation of Australia
- Neurosurgical Society of Australasia
- Scientific Committee American Tinnitus Association
- Scientific Reports – Nature
- Society for Neuroscience (North America)
- Stroke Society of Australasia
- The International Movement Disorder Society (MDS)
- UK Stroke Association
- Wellcome Trust, United Kingdom
- World Federation for Neurorehabilitation
- World Health Organisation – Integrated Care for Older People
- World Health Organisation Global Burden of Disease (GBD) 2013 TBI Panel
- World Stroke Organization

Editorial Boards

BRNZ researchers serve on numerous journal editorial boards. Some examples include:

- American Journal of Physiology
- Audiology and Neurotology
- Australasian Journal on Ageing
- BMC Family Medicine
- Brain and Neurosciences Advances
- Experimental Brain Research
- Frontiers in Neurology
- Frontiers in Psychology
- Frontiers in Systems Neuroscience
- Frontiers of Neuro-Otology Scientific Reports
- Hippocampus
- International Basal Ganglia Society
- International Journal of Audiology
- International Journal of Huntington's Disease
- Journal American Academy of Audiology
- Journal of Alzheimer's Disease
- Journal of Clinical Neuroscience
- Journal of Musculoskeletal and Neuromuscular Interactions
- Journal of Neurology and Therapeutics
- Journal of Neurology, Neurosurgery and Psychiatry
- Journal of Otolaryngology and Hearing and Balance Medicine
- Journal of Speech, Language and Hearing Research
- Kotuitui: New Zealand Journal of Social Sciences Online
- MAI Journal
- Movement Disorders Clinical Practice
- Neurobiology of Learning and Memory
- Neuroepidemiology
- Neuromodulation
- Neuropharmacology
- Neuroscience and Biobehavioural Reviews
- Parkinsonism and Related Disorders
- Scientific Reports – Nature
- Thalamus and Related Systems
- The Open Neurosurgery Journal
- The Open Translational Medicine Journal
- World Journal of Clinical Cases, Annals of Neurology and European Medical Journal – Neurology
- World Neurosurgery

***At right:** Stroke. Coloured magnetic resonance imaging (MRI) scan of the brain of a patient after a cerebrovascular accident (CVA, or stroke). A large infarct (area of dead tissue, yellow) is seen in the sylvian fissure of the right hemisphere (seen here on the left as the brain is viewed from below). The infarct is a result of ischaemia, a lack of blood flow to that area of the brain, caused by a blockage in a blood vessel. The blockage may be due to a thrombus (blood clot) or embolism (air bubble or loose blood clot).*



12.

Our people

Governance Board

BRNZ is privileged to have the support of prominent New Zealanders and academic leaders who are committed to helping us achieve our goals.

Our Governance Board members in 2018:

Sir Don Mckinnon

ONZ GCVO, Chair of Brain Research New Zealand.

Mrs Wendy Fleming

CRSNZ, Chair of Alzheimers New Zealand Charitable Trust, Honorary Vice-President of Alzheimer's Disease International and Past-Chair of Alzheimers New Zealand.

Mr Tony Offen

Dunedin accountant, entrepreneur and member of the Council of the Neurological Foundation of New Zealand.

The Venerable Lloyd Nau Pōpata

Archdeacon of Tāmaki Makaurau, Pou Tikanga – of Ngāti Kahu of Northland.

Prof. Richard Blaikie

Deputy Vice Chancellor (Research and Enterprise) at the University of Otago and Prof. in Physics.

Prof. Max Abbott

Pro-Vice-Chancellor and Dean of the Faculty of Health and Environmental Sciences at AUT, and the Director of the National Institute for Public Health and Mental Health Research.

Prof. John Fraser

Dean of the Faculty of Medical and Health Sciences at the University of Auckland.

Prof. Jim Metson

Deputy-Vice-Chancellor (Research) at the University of Auckland.

Prof. Richard Barker

Pro-Vice-Chancellor (Sciences) at the University of Otago.

Prof. Ian Wright

Deputy-Vice-Chancellor at the University of Canterbury.

Science Advisory Board

BRNZ's Science Advisory Board is made up of five internationally recognised experts in the neurosciences and neurology:

Prof. Stephen Davis

Prof. of Medicine at the University of Melbourne, and President of the Australian and New Zealand Association of Neurologists.

Prof. John Rothwell

Institute of Neurology, University College London.

Prof. Mark Bear

Prof. of Neuroscience of the Picower Institute for Learning and Memory, Massachusetts Institute of Technology, and Howard Hughes Medical Institute.

Prof. A. David Smith

Emeritus Prof., University of Oxford, Founding Director of Oxford Project to Investigate Memory and Ageing.

Prof. John Rostas

Emeritus Prof., Faculty of Health and Medicine, University of Newcastle, past-President of the Australasian Neuroscience Society.

Māori Advisory Board

BRNZ is privileged to be able to call on the expertise of our Māori Advisory Board to provide guidance on the funding of neuroscience research that will have a positive impact on Māori health outcomes.

Dr Waiora Port

(Te Aupouri [Ngāti Pinaki], Te Rarawa [Ngāti Maroki]), BA, MA, PhD, a respected Kuia with long-standing community knowledge of Māori health issues.

The Venerable Lloyd Nau Pōpata

Archdeacon of Tāmaki Makaurau, Pou Tikanga – of Ngāti Kahu of Northland.

Prof. Papaarangi Reid

(Te Rarawa), DipComH, BSc, MBChB, DipObst, FNZCPHM, Tumuaki and Head of Department of Māori Health at the Faculty of Medical and Health Sciences, University of Auckland.

Prof. Michael Walker

(Te Whakatōhea), BSc, MSc, PhD, Fellow of the Royal Society of New Zealand and the Royal Institute of Navigation in London.

Dr Emma Wyeth

BSc (Hons), PhD. Director of Te Rōpū Rangahau Hauora Māori o Ngāi Tahu (Ngāi Tahu Māori Health Research Unit) and a Lecturer in Māori Health, both in the Department of Preventive and Social Medicine at the University of Otago.

Dr Louise Parr-Brownlie

(Ngāti Maniapoto and Ngāti Pikiao), BSc, PhD, neurophysiologist and Kaiārahi at the Otago School of Medical Sciences, University of Otago.

Te Kaanga Skipper

(Tainui), Te Roopu Taurima o Manukau within the Kaupapa Māori Disability Support Service (Korowai Aroha).

Directorate

Prof. Wickliffe Abraham

- Co-Director
- BA with highest distinction, PhD; FRSNZ
- Synaptic plasticity, metaplasticity and the neural mechanisms of memory and Alzheimer's disease

Prof. Peter Thorne

- Co-Director
- BSc, DipSci, PhD; CNZM
- Diseases of the inner ear and the effects of noise and consequences of ageing on the auditory system

Distinguished Prof. Sir Richard Faull

- Māori Engagement and Fundraising
- MBChB, PhD, DSc; KNZM FRSNZ
- Neurodegenerative diseases of the human brain

Prof. Tim Anderson

- Clinical Engagement
- MBChB, FRACP, PhD
- Neurology with special interest in Parkinson's disease

Prof. John Reynolds

- Associate Director, Leadership development and capability building
- MBChB, PhD
- The role of neuromodulation and synaptic plasticity mechanisms in brain areas affected by Parkinson's disease and stroke

Prof. Ruth Empson

- Community Engagement and Education
- MA, PhD, DIC
- Cellular and molecular neuroscience

Associate Prof. Lynette Tippett

- Associate Director, National Director – Dementia Prevention Research Clinics
- MSc (1st), DipClinPsych, PhD
- The clinical and neuropsychological effects of neurological disorders

Dr Hinemoa Elder

- Māori strategic advisor
- MBChB, FRANZCP, PhD

Operations

Alex Sweetman – Business Manager
Ella Fischer – Content Writer and Coordinator
Neka Kater – Administrator
Dianne Stacevicius – Research Administrator
Dr Dean Robinson – Research Operations Manager

Dementia Prevention Research Clinics

AUCKLAND

Associate Prof. Lynette Tippett – National DPRC Director
Dr Phil Wood – Auckland Clinic Co-Director, Geriatrician
Dr Christina Ilse – Consultant Neuropsychologist
Dr Gary Cheung – Old Age Psychiatrist
Dr Kiri Brickell – Neurologist
Jane Govender – Clinical Research Co-Ordinator, Research Nurse
Christine Brennan – Research Nurse
Dr Susan Yates – Clinical Neuropsychologist
Dr Annabelle Claridge – Clinician older adults
Keith Woods – Clinical Psychologist, Neuropsychologist
Dr Erin Cawston – DPRC Tissue Bank Research Fellow
Celestine Wong – DPRC Tissue Bank Technologist
India Wallace – DPRC Tissue Bank Technologist
Dr Catherine Morgan – Research Fellow
Prof. Ian Kirk – Prof. Neuroimaging
Associate Prof. Debbie Young – DPRC Biobank Co-Director

CHRISTCHURCH

Prof. Tim Anderson – Christchurch DPRC Co-Director, Neurologist
Prof. John Dalrymple Alford – Christchurch DPRC Co-Director, Psychologist
Dr Tracy Melzer – Senior Research Fellow
Dr Toni Pitcher – Research Fellow
Karelia Levin – Neuropsychologist
Marie Goulden – Research Coordinator
Dr John Elliot – General Physician and Specialist in the Elderly
Dr Campbell Le Heron – Neurologist

DUNEDIN

Dr Nick Cutfield – Dunedin DPRC Director, Neurologist
Associate Prof. Joanna Williams – DPRC Biobank Co-Director
Tina Edgar – Research Technician
Annabel Dawson – Neuropsychologist
Debra McNamara – Clinical Research Nurse

BRNZ investigators

NAME	POSITION TITLE	INSTITUTION	BRNZ STATUS
Wickliffe Abraham	Prof.	University of Otago	Co-Director, PI
Peter Thorne	Prof.	University of Auckland	Co-Director, PI
John Reynolds	Prof.	University of Otago	Associate Director, PI
Lynette Tippett	Associate Prof.	University of Auckland	Associate Director, PI
Tim Anderson	Prof.	University of Otago	Directorate member, PI
Richard Faull	Distinguished Prof. Sir	University of Auckland	Directorate member, PI
Ruth Empson	Prof.	University of Otago	Directorate member, Theme Leader and PI
Tim David	Prof.	University of Canterbury	Theme Leader and PI
Ian Kirk	Prof.	University of Auckland	Theme Leader and PI
Ngaire Kerse	Prof.	University of Auckland	Theme Leader and PI
Monica Acosta	Dr	University of Auckland	Principal Investigator
Donna Rose Addis	Prof.	University of Auckland	Principal Investigator
Alan Barber	Prof.	University of Auckland	Principal Investigator
Nigel Birch	Associate Prof.	University of Auckland	Principal Investigator
Margaret Brimble	Distinguished Prof. Dame	University of Auckland	Principal Investigator
Winston Byblow	Prof.	University of Auckland	Principal Investigator
Bronwen Connor	Prof.	University of Auckland	Principal Investigator
Garth Cooper	Prof.	University of Auckland	Principal Investigator
Sarah Cullum	Dr	University of Auckland	Principal Investigator
Maurice Curtis	Prof.	University of Auckland	Principal Investigator
Mike Dragunow	Prof.	University of Auckland	Principal Investigator
Makarena Dudley	Dr	University of Auckland	Principal Investigator
Jian Guan	Associate Prof.	University of Auckland	Principal Investigator
Janusz Lipski	Prof.	University of Auckland	Principal Investigator
Johanna Montgomery	Associate Prof.	University of Auckland	Principal Investigator
Suzanne Purdy	Prof.	University of Auckland	Principal Investigator
Grant Searchfield	Associate Prof.	University of Auckland	Principal Investigator
Russell Snell	Prof.	University of Auckland	Principal Investigator
Cathy Stinear	Associate Prof.	University of Auckland	Principal Investigator
Srdjan Vlajkovic	Associate Prof.	University of Auckland	Principal Investigator
Debbie Young	Associate Prof.	University of Auckland	Principal Investigator
Valery Feigin	Prof.	Auckland University of Technology	Principal Investigator
Nicola Kayes	Associate Prof.	Auckland University of Technology	Principal Investigator
Denise Taylor	Prof.	Auckland University of Technology	Principal Investigator
Andrew Clarkson	Dr	University of Otago	Principal Investigator
Nick Cutfield	Dr	University of Otago	Principal Investigator
Dirk De Ridder	Prof.	University of Otago	Principal Investigator
Leigh Hale	Prof.	University of Otago	Principal Investigator
Stephanie Hughes	Dr	University of Otago	Principal Investigator
Brian Hyland	Prof.	University of Otago	Principal Investigator
Steve Kerr	Associate Prof.	University of Otago	Principal Investigator
Ping Liu	Associate Prof.	University of Otago	Principal Investigator
Liana Machado	Dr	University of Otago	Principal Investigator
Tracy Melzer	Dr	University of Otago	Principal Investigator
Pauline Norris	Prof.	University of Otago	Principal Investigator
Louise Parr-Brownlie	Dr	University of Otago	Principal Investigator
Richie Poulton	Prof.	University of Otago	Principal Investigator
Holger Regenbrecht	Associate Prof.	University of Otago	Principal Investigator
Ted Ruffman	Prof.	University of Otago	Principal Investigator
Phil Sheard	Associate Prof.	University of Otago	Principal Investigator
Paul Smith	Prof.	University of Otago	Principal Investigator
Warren Tate	Prof.	University of Otago	Principal Investigator
Ian Tucker	Prof.	University of Otago	Principal Investigator
Joanna Williams	Associate Prof.	University of Otago	Principal Investigator
Yiwen Zheng	Associate Prof.	University of Otago	Principal Investigator
John Dalrymple-Alford	Prof.	University of Canterbury	Principal Investigator
Gary Cheung	Dr	Auckland District Health Board	Principal Investigator
Richard Roxburgh	Dr	Auckland District Health Board	Principal Investigator
Suzanne Barker-Collo	Associate Prof.	University of Auckland	Associate Investigator
Erin Cawston	Dr	University of Auckland	Associate Investigator
Melanie Cheung	Dr	University of Auckland	Associate Investigator
Michelle Glass	Prof.	University of Auckland	Associate Investigator
Andrea Kwakowsky	Dr	University of Auckland	Associate Investigator
Simon O'Carroll	Dr	University of Auckland	Associate Investigator
Cris Print	Associate Prof.	University of Auckland	Associate Investigator
Henry Waldvogel	Associate Prof.	University of Auckland	Associate Investigator
Rita Krishnamurthi	Dr	Auckland University of Technology	Associate Investigator
Michael Black	Associate Prof.	University of Otago	Associate Investigator
Anne-Marie Jackson	Dr	University of Otago	Associate Investigator
Ailsa McGregor	Dr	University of Otago	Associate Investigator
Toni Pitcher	Dr	University of Otago	Associate Investigator
Reremoana Theodore	Dr	University of Otago	Associate Investigator
Ed Mee	Dr	Auckland District Health Board	Associate Investigator
Barry Snow	Associate Prof.	Auckland District Health Board	Associate Investigator
Phil Wood	Dr	Auckland District Health Board	Associate Investigator
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Karen Brewer	Post-doctoral fellow	University of Auckland
John Cirillo	Post-doctoral fellow	University of Auckland
Natacha Coppieters	Post-doctoral fellow	University of Auckland
Victor Dieriks	Post-doctoral fellow	University of Auckland
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Kathryn Jones*	Post-doctoral fellow	University of Auckland
Owen Jones*	Post-doctoral fellow	University of Otago
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Dionghyo Joseph Kim	Post-doctoral fellow	University of Otago
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Kevin Lee	Post-doctoral fellow	University of Auckland
Carl Leichter	Post-doctoral fellow	University of Otago
Shelly Lin	Research fellow	University of Auckland
Sue Lord	Post-doctoral fellow	Auckland University of Technology
Vicky Low	Post-doctoral fellow	University of Auckland
Natalie Matheson	Post-doctoral fellow	University of Otago
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Anurag Singh	Post-doctoral fellow	University of Otago
Malvindar Singh-Bains	Post-doctoral fellow	University of Auckland
Leon Smyth	Post-doctoral fellow	University of Auckland
Andreas Stenling	Post-doctoral fellow	University of Otago
Louise Stubbing	Post-doctoral fellow	University of Auckland
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** denotes PDFs who have received direct funding by Brain Research New Zealand*

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Chitra Vinnakota	Other	University of Auckland
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Zoe Woolf	Other	University of Auckland
Shane Witehira	Other	University of Otago
Jiani Xu	Other	University of Auckland
Brian Yeom	Other	University of Auckland
Jason Yeung	Other	University of Auckland
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Jiaxin Zhang	Doctoral Degree	University of Otago
Lisa Zhou	Doctoral Degree	University of Otago

*** denotes students whose tuition has been directly funded by Brain Research New Zealand*

13.

Research outputs

One of the important ways BRNZ contributes to the economy is through research publications, where we share research findings with other researchers, policymakers, and communities globally.

Patents Filed

1. Clarkson, A. "Compounds for the treatment of acute brain injury". 2018 Preliminary Patent (PA 2018 70067) was filed jointly between the University of Copenhagen and the University of Otago.
2. Reynolds, J. N. J., Tan, E. W., Hyland, B. I., Jameson, G. N. L., Myint, M. A. M., Mackay S. M., and Wickens, J. R. "Acoustic driven drug delivery systems". 2018 Patent Application No. PCT/NZ2016/050130 Australian priority date 21 August 2015, AU 2015903387

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15. Dieriks, B.V., Stevenson, T., Murray, H.C., Faull, R.L.M., Dragunow, M. & Curtis, M.A. (2018). Non-neuronal cells enable transmission of α-synuclein in Parkinson's disease. 36th Australasian Winter Conference on Brain Research, AWCBR, Queenstown.

16. Elder, M., Tate, W.P., Abraham, W.C., Schuman, E. & Williams, J.M. (2018) Secreted amyloid precursor protein alpha regulates AMPA receptor synthesis and trafficking. Australasian Neuroscience Society, (Brisbane).

17. Empson, R. (2018). Establishing reliable methods to assess motor skill learning and motor performance in mice. Proceedings of the 35th International Australasian Winter Conference on Brain Research, 50.

18. Erkelens, I., Bobier, W.R., MacMillan, A., Maione, N., Calderon, C.M., Patterson, H. & Thompson, B. (2018). The cerebellar oculomotor vermis is involved in reflexive but not tonic vergence adaptation. *Investigative Ophthalmology & Visual Science 59(9)*, 4414-4414.

19. Fa'alau, F., Kautoke, S., Havea, M., Addis, D., Kerse, N. and Cullum, S. (2018). The lived experience of dementia in New Zealand pacific communities. *Australian and New Zealand Journal of Psychiatry 52*, 61. Retrieved http://www.otago.ac.nz/awcbr/index.html.

20. Freestone, P., Todd, K., Trew, M., Halum, L. & Lipski, J. (2018). An optogenetic channelrhodopsin-assisted mapping investigation of network organization within the subthalamic nucleus. FENS Forum of Neurocience, Berlin, Germany.

21. Gillon, A.P., Cornwall, J.C. & Sheard P.W. (2018). Age-associated changes in motoneuron number, nucleocytoplasmic transport proteins and nuclear permeability. Society on Sarcopenia, Cachexia & Muscle wasting Disorders.

22. Gillon, A. & Sheard, P. (2018). Age-related skeletal muscle atrophy may be driven by defects at the motoneuron nuclear envelope. *Australasian Journal on Ageing.*

23. Govindpani, K., Mistry, V., Synek, B., Turner, C., Dragunow, M., Waldvogel, H., Faull, R.L.M. & Kwakowsky, A. (2018). Cerebrovascular expression of GABA signalling components in the human middle temporal gyrus. FENS Conference.

24. Guzman, F., Waters, S., Fuhrer, T., Palpagama, T., Tate, W., Dragunow, M., Waldvogel, H., Faull, R.L.M. & Kwakowsky, A. (2018). Beta-amyloid induced molecular and cellular changes in an in vivo mouse model of Alzheimer's disease. FENS Conference.

25. Hariharan, A., Jing, Y., Collie, N.D., Zhang, H. & Liu, P. (2018). Endothelial nitric oxide synthase deficiency alters neurovascular coupling and brain glutamine metabolism. The 30th Alzheimer's Association International Conference, Chicago, USA.

26. Hariharan A., Jing, Y., Collie, N.D., Zhang, H. & Liu, P. (2018). Increased urea levels in the brain of endothelial nitric oxide synthase deficient mice. The 30th Alzheimer's Association International Conference, Chicago, USA.

27. Hariharan, A., Jing, Y., Collie, N.D., Zhang, H. & Liu, P. (2018). Endothelial nitric oxide synthase deficiency leads to increased urea levels in the brain. 36th International Australasian Winter Conference on Brain Research, Queenstown, New Zealand.

28. Highet, B., Dieriks, B.V., Murray, H.C., Faull, R.L.M. & Curtis, M.A. (2018). Presence of mutant huntingtin aggregates in the anterior olfactory nucleus of the human Huntington's disease olfactory bulb. Conference on Rare Genetic Diseases of the Brain, Queenstown Research Week.

29. Jansson, D., Smyth, L., Rustenhoven, J., Scotter, E.L., & Dragunow, M. (2018). PDGFRß-dependent signalling in human brain pericytes. Barriers of the CNS Gordon Research Conference - Exploring Novel Technologies to Overcome Present Challenges in Understanding Brain Barriers Function, Colby-Sawyer College, New London.

30. Jeung, J., Calvo-Flores Guzman, B., Tate, W.P., Waldvogel, H.J., Faull, R.L.M. & Kwakowsky, A. (2018). Alterations in glutamate receptor and transporter expression in the hippocampus of an *in vivo* Alzheimer`s disease mouse model. 38th Annual Scientific Meeting of the Australasian Neuroscience Conference (ANS), Brisbane, Australia

31. Jimenez Martin, J., Potapov, D., Knopfel, T., & Empson R (2018). Genetically encoded voltage indicators for imaging synaptic circuit activity. Australasian Neuroscience Society ANS 38th Annual Meeting. Invited Speaker at Symposium "Exploring neuronal function through advanced imaging techniques".

32. Jimenez Martin, J., Potapov, D., Knopfel, T., & Empson R (2018). Dynamics of cortical motor maps during motor learning. Australasian Neuroscience Society ANS 38th Annual Meeting. Invited Speaker at Symposium "Sensory and motor processing in cortical circuits *in vivo*"

33. Krishnamurthi, R., Cullum, S., Havea, M. & Kerse, N. (2018). The lived experience of dementia in New Zealand Indian communities. *Australian and New Zealand Journal of Psychiatry 52*, 61.

34. Kumarasinghe, K., Owen, M., Kasabov, N., Taylor, D. & Au, C. (2018). FaNeuRobot: A Brain-Like Motor Controlling Framework for Prosthetic Control using Automata Theory, Cognitive computing & NeuCube Evolving Spiking Neural Network Architecture. Proceedings 2018 IEEE International Conference on Robotics and Automation (ICRA) (pp. 4465-4471). Brisbane. doi:10.1109/ICRA.2018.8460197

35. Kwakowsky, A., Pandya, M., Waldvogel, H.J., & Faull, R.L.M. (2018). Age- and gender-specific expression changes of the GABAA receptor subunits in the human cortex. 11th FENS forum of Neuroscience 2018, Berlin, Germany.

36. Lal, N., Cornwall, J., Slatter, T. & Sheard, P. (2018). Identification of denervated fibers in elderly skeletal muscles. *Australasian Journal on Ageing.*

37. Lal, N., Cornwall, J., Slatter, T. & Sheard, P. (2018). p62/SQSTM1 accumulates in late stage autophagic organelles within the myotendinous regions of elderly mouse skeletal myofibers. Society on Sarcopenia, Cachexia & Muscle wasting Disorders.

38. Liew, S.L., Jahanshad, N., MacIntosh, B.J., Robertson, A.D., Wang, J., Soekadar, S., Marguiles, D.S., Lotze, M., Domin, M., Byblow, W.D., Stinear, C.M., Westlye, L.T., Ramos, R., Birbaumer, N., Wiest, R., Ward, N., Anglin, J.M., Winstein, C.J., Aziz-Zadeh, L., Roberts, P., Goud, A., Borich, M.R., Wittenberg, C., Lang, C.E., Kuceyeski, A., Kautz, S., Hanlon, C., Cramer, S.C. & Thompson, P.M. (2018). Subcortical Volumes Associated With Post-Stroke Motor Performance Vary Across Impairment Severity, Time Since Stroke, and Lesion Laterality: an ENIGMA Stroke Recovery Analysis. International Stroke Conference, Los Angeles, USA.

39. Liu, P., Jing, Y., Collie, N.D., Dean, B., Bilkey, D.K. & Zhang, H. (2018). Altered arginine metabolism in the frontal cortex of patients with major depression. 36th International Australasian Winter Conference on Brain Research Queenstown, New Zealand.

40. Livingstone, R., Elder, M.K., Barrett, M., Westlake, C., Tate, W.P., Abraham, W.C. & Williams, J.M. (2018). Arc protein expression in response to secreted amyloid precursor protein-α in primary hippocampal cultures. Proceedings of the 36th International Australasian Winter Conference on Brain Research.

41. Macapagal, J., Park, T. I-H., Joret, M.O., Rustenhoven, J., Dieriks, B.V., Faull, R.L.M., Schweder, P. & Dragunow, M. (2018). Pericytes can contribute to tumour immune system evasion in glioblastoma multiforme through dampened expression of ICAM-1, VCAM-1 and MCP-1. 36th International Australasian Winter Conference on Brain Research Queenstown, New Zealand.

42. Martin, J.J., Potapov, D. & Empson, R. (2018). Transcriptome profiling of layer 5 intratelencephalic projection neurons from the mature mouse motor cortex. Invited Presentation Europhysiology 2018.

43. Martin, J.J., Potapov, D. & Empson, R. (2018). Genetically encoded voltage indicators for imaging synaptic circuit activity. Australasian Neuroscience Society ANS 38th Annual Meeting Invited Speaker at Symposium "Exploring neuronal function through advanced imaging techniques".

44. Martin, J.J., Potapov, D. & Empson, R. (2018). Dynamics of cortical motor maps during motor learning. Australasian Neuroscience Society ANS 38th Annual Meeting Invited Speaker at Symposium "Sensory and motor processing in cortical circuits *in vivo*"

45. Mathiesen, S.N., Ohline, S.M., Wicky, H.E., Cheong, M.Y.I., Abraham, W.C. & Hughes, S.M. (2018). Assessing the efficacy of a novel AAV capsid in targeting the brain. 243rd Otago Medical School Research Society.

46. Mugisho, O.O., Green, C.R., Squirrell, D., Bould, S., Zhang, J., Acosta, M. & Rupenthal, I.D. (2018). Intravitreal pro-inflammatory cytokines induce signs of diabetic retinopathy in non-obese diabetic mice. Annual Meeting of the Association-for-Research-in-Vision-and-Ophthalmology (ARVO)

47. Ng, J.Y., Merry, T.L., Scheepens, A., Abraham, W.C., Hickey, A.J.R. & Birch, N.P. (2018). The effect of urolithin A on neuronal mitochondrial redox activity, mitochondrial respiration and mitochondrial networks. Society for Neuroscience.

48. Park, T. I-H., Lee, K., Schweder, P., Dieriks, B. V., Jung, Y-W., Montgomery, J. & Dragunow, M. (2018). Growing primary adult human neurons to study neurological diseases. Cold Spring Harbor Asia – Latest Advances in Development & Function of Neuronal Circuits.

49. Pearson, G.M., Kerse, N., Moyes, S., Muru-Lanning, M.L. & Teh, R. (2018). The impact of depression on the morbidity and mortality of› 85s in New Zealand. *Journal of the American Geriatrics Society 66*, s92.

50. Potemkin, N., Tate, W.P., & Williams, J.M. (2018). Amyloid-ß increases SH-SY5Y neuroblastoma cell viability. Proceedings of the 36th International Australasian Winter Conference on Brain Research.

51. Raveendran, R.N., Krishnan, A.K. & Thompson, B. (2018). Reduced fixation stability during a peripheral orientation discrimination task in participants with normal vision. *Investigative Ophthalmology & Visual Science 59* (9), 12300.

52. Reynolds, J., Hyland, B., Wickens, J. & Tan, E. (2018). Emulating the natural timing of dopamine receptor activation in Parkinson's Disease. *Movement Disorders*.

53. Roy, J., Garvey, A., Guévremont, D., Cutlfield, N.J. & Williams, J.M. (2018). MicroRNA expression in the diagnosis of Parkinson's disease. Proceedings of the 36th International Australasian Winter Conference on Brain Research.

54. Rustenhoven, J., Smith, A., Smyth, L., Jansson, D., Copieters, N., Narayan, P., Park, T., Schweder, P., Heppner, P., Curtis, M., Faull, R.L.M. & Dragunow, M. (2018). The transcription factor PU.1 regulates a network of innate and adaptive immune mediators in primary human microglia: implications for Alzheimer's disease. Keystone Symposia – Advances in Neurodegenerative diseases research and therapy & New Frontiers in Neuroinflammation.

55. Ryan, M.M., Guévremont, D., Mockett, B.G., Abraham, W.C., Williams, J.M. (2018). Circulating plasma microRNA are altered with amyloidosis in a mouse model of Alzheimer's disease. Society for Neuroscience 48th Annual Meeting (San Diego, CA).

56. Schweitzer, L., Tok, S., De Villele, L., Wicky, H.E., Abraham, W.C. & Hughes, S.M. (2018). A new mouse model for Alzheimer's disease. Gordon Research Conference Neurobiology of Brain Disorders.

57. Searchfield, G.D. (2018). Throwing the ball further: What tinnitus research can learn from Team New Zealand's winning of yachting's Americas Cup. Paper presented at the Disruptive Innovations in Tinnitus, 11th International TRI Tinnitus Conference, Regensburg, Germany.

58. Searchfield, G. D. (2018). Sound therapy and Aural Rehabilitation for Tinnitus (START): A person centred therapy framework based on an ecological model of tinnitus. *Disability and rehabilitation*, 1-8. Sonova Zurich.

59. Searchfield, G. D. (2018). The performance of the AutoSense OS classifier compared to hearing aid users' manual selection of listening programs. *International journal of audiology 57(3)*, 201-212. Sonova Zurich.

60. Seo, S., Kohe, S. E., Gowing, E., Zheng, Y., Kokay, I., Grattan, D. R., Liu, P. & Oorschot, D. E. (2018). Effect of extreme prematurity on brain monoamine metabolism. Proceedings of the Society for Neuroscience 47th Annual Meeting. 035.06/C44. SfN.

61. Sheard, P. K. Nielsen, J. Cornwall, T. Slatter, & N. Lal. (2018). Myofibre death is not a major contributor to age-relates skeletal muscle atrophy. Society on Sarcopenia, Cachexia & Muscle wasting Disorders.

62. Shim, V. B., Li, S. & Dragunow, M. (2018). Parametric analysis of the pattern of damage in traumatic brain injuries. 8th world Congress of Biomechanics, Dublin Ireland.

63. Siemens, A.D., Jansson, D., Curtis, M.A., Faull, R.L.M., Dragunow, M., Scotter, E. (2018). Identification of RNA foci in cultured C9ORF72-positive human spinal cord pericytes. Australian Motor Neurone Disease Symposium, Melbourne Convention and Exhibition Centre, Melbourne.

64. Smith, M-C., Barber, A., Ackerley, S., Byblow, W. & Stinear, C. (2018). The PREP2 algorithm predicts upper limb functional outcomes at 3 months and 2 years post-stroke. *International Journal of Stroke*.

65. Smyth, L., Rustenhoven, J., Jansson, D., Park, T.I.H. & Dragunow, M. (2018). Inflammatory responses are differentially regulated in blood-brain barrier pericytes and endothelia. Barriers of the CNS Gordon Research Conference - Exploring Novel Technologies to Overcome Present Challenges in Understanding Brain Barriers Function, Colby-Sawyer College, New London.

66. Stevenson, T., Dieriks, V., Dragunow, M., Curtis, M. (2018). Quantification of non-neuronal cells containing intracellular α-synuclein in the human Parkinson's disease olfactory bulb. 36th International Australasian Winter Conference on Brain Research Queenstown, New Zealand.

67. Swanson, M.E.V., Murray, H.C., Ryan, B., Faull, R.L.M., Dragunow, M. & Curtis, M.A. (2018). Microglial immunophenotype markers are expressed on activated microglia in the normal aged post-mortem human cortex. EMBO Microglia International Conference, Heidelberg, Germany.

68. Tan, A.Y.S., Singh-Bains, M.K., Mehrabi, N.F., Faull, R.L.M. & Dragunow, M. (2018). Characterisation of the neurovascular unit in Huntington's disease using human tissue microarrays. Proceedings of the 38th Annual Meeting of the Australasian Neuroscience Society.

69. Tan, A.Y.S., Singh-Bains, M.K., Mehrabi, N.F., Faull, R.L.M. & Dragunow, M. (2018). Characterisation of classical Huntington's disease neuropathology in a human tissue microarray. 36th Australasian Winter Conference on Brain Research, AWCBR, Queenstown.

70. Park, T.I-H., Kim, K., Macapagal, M., Dieriks, V., Schweder, P., Heppner, P., Turner, C., Curtis, M. & Dragunow, M. (2018). PSA-NCAM in Glioblastoma – A negative prognostic marker and a therapeutic target? 23rd Annual Scientific Meeting of the Society for Neurooncology.

71. Todd, K., Lipski, J., Freestone, P. (2018). The subthalamic nucleus modulates striatal dopamine release. FENS Forum of Neuroscience, Berlin, Germany.

72. Vautrelle, J., Bergin, D. H., Gray, J. P., Bergin, R., Leriche, M., Fuller, J., Hyland, B. I., Mckay, S., Tan, E. W. & Reynolds, R. (2018). Development of a minimally-invasive technology for spatially- and temporally-controlled drug delivery into the brain. 36th Australasian Winter Conference on Brain Research, AWCBR, Queenstown.

73. Vinnakota, C., Govindpani, K., Calvo-Flores Guzman, B., Waldvogel, H.J., Faull, R.L.M, & Kwakowsky, A. (2018). Extrasynaptic alpha 5 type GABAA receptors as therapeutic targets for Alzheimer's disease. Exposure 2016, University of Auckland.

74. Vlajkovic, S.M., Fok, C., Bogosanovich, M. & Thorne, P.R. (2018). Adenosine receptor-based strategies for cochlear rescue from injury. Proceedings of the Australian Neuroscience Society Meeting, Brisbane, Australia.

75. Vlajkovic, S.M., Fok, C., Bogosanovich, M. & Thorne, P.R. (2018). Regulators of G protein Signalling as novel targets for the treatment of sensorineural hearing loss. Proceedings of the 55th Inner Ear Biology Workshop, Berlin, Germany.

76. Vlajkovic, S.M., Fok, C., Bogosanovich, M. & Thorne, P.R. (2018). Cochlear rescue from noise-induced hearing loss by inhibition of the molecular complex which regulates adenosine A1 receptor signalling. Proceeding of the Purines 2018, Foz do Iguaçu, Brazil.

77. Waldvogel, W.J., McCafferty, E., Sehji, T., Mehrabi, N.F., Singh-Bains, M.K. & Faull, R.L.M. Distribution of GABAA receptor subunits in the normal and Huntington's disease cerebellum. Conference of the Federation of European Neuroscience Societies (FENS), Berlin, Germany.

78. Ward, S., Wiedemann, L., Stinear, C., Stinear, J. & McDaid, A. (2018). Lower limb EMG activity of chronic stroke patients when using a novel gait-retraining device. XXII Congress of the International Society of Electrophysiology and Kinesiology.

79. Waters, S., Dieriks, V., Swanson, M., Grimsey, N., Murray, H., Waldvogel, H., Curtis, M.A., Faull, R.L.M., Dragunow, M. & Scotter, E. (2018). Loss of Blood-Spinal Cord Barrier Integrity Displays Regional Patterning in Amyotrophic Lateral Sclerosis. Australian Motor Neurone Disease Symposium.

80. Williams, J.M., Elder, M.K. & Tate, W.P. (2018). Cell surface expression of GluA1-containing AMPA receptors is enhanced by secreted amyloid precursor protein-alpha; visualized by BioPLAy. Neuroscience 48th Annual Meeting, San Diego, CA.

81. Young, D. (2018). Targeting the NMDA receptor as an immunotherapeutic approach to promote cognitive function. 14th International Congress of Neuroimmunology.

82. Zhang, J., Jing, Y., Zhang, H., Bilkey, D.K. & Liu, P. (2018). Maternal immune activation affects hippocampal nNOS immunoreactivity and microglia in postnatal day 35 rat offspring. 36th International Australasian Winter Conference on Brain Research, Queenstown, New Zealand.

83. Zheng, Y., Aa, J., He, J., Wang, G. & Smith, P. F. (2018). Can metabolic changes in the blood predict changes in the brain in rats following acoustic trauma? Proceedings of the 36th International Australasian Winter Conference on Brain Research.

14.

Our partners

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UC UNIVERSITY OF CANTERBURY

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND
SAPERE AUDE

AUT UNIVERSITY
AUCKLAND, NEW ZEALAND

15.

Our collaborators

National

- Alzheimers New Zealand
- Auckland District Health Board
- Australian Neuroscience Society
- Brain Health Research Centre
- Canterbury District Health Board
- Centre for Brain Research
- Counties Manukau District Health Board
- Medical Technologies Centre of Research Excellence
- Mercy Hospital, Auckland
- National Institute for Stroke and Applied Neurosciences
- Neurological Foundation of New Zealand
- New Zealand Brain Research Institute
- New Zealand Dementia Prevention Trust
- Pacific Radiology
- Pegasus Healthcare, Canterbury
- Plant and Food Research
- Puketeraki marae, Ōtepoti (Dunedin)
- Southern District Health Board
- Te Kura Kaupapa Māori o Hoani Waititi
- The New Zealand – China Non-Communicable Diseases Research Collaboration Centre
- University of Otago, Cancer Society Tissue Bank
- Waitemata District Health Board

International

- Comenius University of Bratislava, Slovakia
- Frankfurt University, Germany
- Fudan University and Huashan Hospital, Shanghai, China
- IBM Research, Healthcare and Life Sciences Research, USA
- Imperial College London, UK
- Macquarie University and Centre of Excellence for Alzheimers disease research and care, Australia
- Neurology Department of Ruijin Hospital, Shanghia, China
- Okinawa Institute for Science and Technology, Japan
- Pomona College, USA
- Macquarie University, Sydney
- Melbourne Neuroscience Centre, Australia
- Rosalind Franklin University of Medicine and Science, USA
- Shanghai Mental Health Centre
- Sheffield University, UK
- The Alzheimer's Disease and other Cognitive Disorders Unit, the Hospital Clinic Barcelona, Spain
- The Cognitive Impairment Unit Lleida, Spain
- Umeå University, Sweden
- University of Barcelona, Spain
- University of Birmingham, UK
- University of California San Francisco, USA
- University of California, Los Angeles, USA
- University of Queensland, Australia
- University of Texas, Austin, USA
- University of Utah, USA
- University of Western Australia
- University of Windsor, Ontario, Canada

16.

Financial statement

FUNDING SUMMARY FOR THE YEAR ENDED 31 DECEMBER 2018

	2018
Funding Received	$000
Tertiary Education Commission grant	4,972
Surplus/Deficit carried forward	1,145
Total Funding received	
Expenditure[2]	
Salaries	1,372
Overheads	1,486
Project costs	1,801
Postgraduate students	627
Travel	275
Extraordinary Expenditure[3]	29
Subcontractors[4]	268
Total Expenses	5,858
Net surplus/(Deficit) 5	

*All amounts are shown exclusive of Goods and Service tax (GST)

NOTES

1. This financial report is for the period 1st January to 31st December 2018. This report only contains details of funding and expenditure relating to the CoRE grant that the Centre receives from the Tertiary Education Commission. It does not contain details of philanthropic funding, or operating funding to Centre investigators from other funding agencies.
2. This funding summary details funding received and funds distributed to collaborative partners of the CoRE.
3. The extraordinary expenditure budget is for Governance board meeting expenses.
4. In 2018 BRNZ carried forward a net surplus of 1,145. This surplus has been added to BRNZ's 2018 income to fund the CoRE's research programme in 2018. BRNZ therefore has a net surplus of 259 that will be carried forward into 2019 to fund future expenditure of the CoRE.

17.

Table of statistics

BROAD CATEGORY	DETAILED CATEGORY	YR 4
Value of CoRE funding from TEC ($M)		**$4.972**
FTEs by category	Principal investigators	6.83
	Associate investigators	2.92
	Postdoctoral fellows	23.45
	Research technicians	21.93
	Administrative/support	7.2
	Research students	175.75
	Total	**238.08**
Headcounts by category	Principal investigators	59
	Associate investigators	30
	Postdoctoral fellows	65
	Research technicians	53
	Administrative/support	15
	Research students	186
	Total	**408**
Peer reviewed research outputs by type	Books	0
	Book chapters	7
	Journal articles	195
	Conference papers	84
	Other	0
	Total	**284**
Value of external research contracts awarded by source ($000)	Vote Science and Innovation contestable funds	5,409
	Other NZ Government	132
	Domestic – private sector funding	399
	Overseas	494
	Other	1,563
	Total	**8,997**
Commercial activities	Number of licenses	0
	Income from licenses	0
	Patent applications	2
	Patents granted	0
	Invention disclosures	0
	Number of new spinouts	0
	Capitalisation value of spinouts	0
Students studying at CoRE by level	Doctoral degree	125
	Other	61
	Total	**186**
Number of students completing qualifications by level	Doctoral degree	10
	Other	20
	Total	**30**
Immediate post-study graduate destinations	Further study in NZ	8
	Further study overseas	1
	Employed in NZ	8
	Employed overseas	1
	Unknown	12
	Other	-
	Total	**30**

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Brain Research
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