BRAIN RESEARCH NEW ZEALAND

ANNUAL REPORT 2019

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 conditions. We bring together New Zealand's best neuroscientists and clinicians, and work in partnership with Māori and community organisations to combat neurological disorders such as stroke, Parkinson's and Alzheimer's diseases. Our ultimate aim is to improve brain health for all New Zealanders in the years to come.

Brain Research
NEW ZEALAND
Rangahau Roro Aotearoa

brnz.ac.nz

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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 New Zealand.

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.

CO-DIRECTORS' REPORT

Hallmarks of quality

"With ongoing efforts by the BRNZ teams, it's our hope to show that as age increases, quality of life need not decline."

PROFESSOR CLIFF ABRAHAM

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2019 marked the fifth year of Brain Research New Zealand-*Rangahau Roro Aotearoa*, and another twelve months of working long and hard with students, researchers, clinicians, Māori and community groups to improve brain health and to combat ageing-related neurological disease.

AS a Centre of Research Excellence that stretches across New Zealand, we strive for the highest possible quality in everything that we do: our world-class interdisciplinary research programme is sustained by the excellence of our postgraduate training, and by the strength of our community partnerships and international collaborations.

The end goal, is to help New Zealanders achieve and maintain as high a quality of life as possible during ageing. What this means will depend of course on an individual's circumstances. But each person can strive to maximise their activity and variety in life, through physical and mental exercise and social engagement.

Building on BRNZ's work to date, this year's innovative and leading-edge research has been helping us understand more, not just about normal brain ageing, but also about neurological disorders such as stroke, Parkinson's and Alzheimer's diseases - who gets them, what causes them, and how they progress. Our research is also revealing why the progression of a specific disease can differ so greatly from one person to the next. Using this knowledge, we are working harder than ever to develop better diagnostic tools, new and improved treatments, and even potential ways of delaying or preventing these debilitating conditions. BRNZ's researchers published over two hundred high quality peer-reviewed journal articles in 2019, each one representing yet another step towards achieving our goals. With ongoing efforts by the BRNZ teams, it's our hope to show that as age increases, quality of life need not decline.

In the pages that follow we invite you to learn what quality means, not just to BRNZ, but to the many and diverse groups and individuals involved in the work we do. And as the new decade begins, we ask you to think about your own brain health and to consider – "what does quality of life mean to me?"

Professor Peter Thorne
(University of Auckland)
Co-Director
Brain Research New Zealand-*Rangahau Roro Aotearoa*

Professor Cliff Abraham
(University of Otago)
Co-Director
Brain Research New Zealand-*Rangahau Roro Aotearoa*

2019 AT A GLANCE

OUR PEOPLE

4 4 universities, 72 Principal and Associate Investigators

74 Postdoctoral fellows

12 clinicians

14% identify as Māori

RESEARCH HIGHLIGHTS

273 peer-reviewed journal articles

1 patent

$16M in external research funding

43 internationally collaborative research projects

DEMENTIA PREVENTION RESEARCH CLINICS

3 3 clinics, 5 DHBs

275 study participants

16 research projects

95% retention rate

TRAINING AND EDUCATION

137 PhD students

56 qualification completions

37 Travel grants

75 emerging researchers attended our 2019 ECR Workshop

MĀORI SUCCESS

23 Māori emerging researchers

64 members have completed Takarangi training courses

$2M invested in Kaupapa Māori research

8 Māori specific research projects

COMMUNITY ENGAGEMENT

1250+ people attended a performance of *The Keys Are in the Margarine*

350 schools have registered for the Being Brainy Programme

BRNZ researchers appeared in the media on average 6 times a week

$4.4M in philanthropic funding raised to support our research

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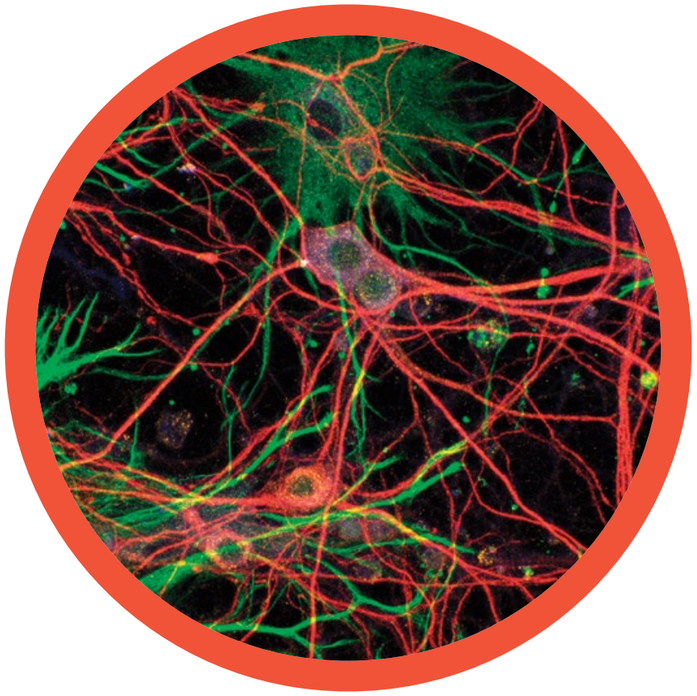
Quality means ...

LEADING EDGE RESEARCH THAT MAKES A DIFFERENCE

being built on effective national partnerships between researchers, clinicians, Māori and the community.



BRNZ's central mission is to undertake the highest quality research possible to understand and promote brain health during ageing. Our body of work covers both biomedical and clinical research, using modern, innovative approaches and state-of-the-art methodologies. It also embraces kaupapa Māori methodologies in the Māori health research space. Below we summarise some of the outstanding work being undertaken by investigators.

ABOVE:
Image of neural cells maintained in culture conditions. Nerve cells are shown in red, and a non-neural cell type called astrocytes are shown in green. Molecules associated with neuroinflammation, as in Alzheimer's and other brain diseases, are shown in green and gold. The Abraham lab study aims to identify which cell types express inflammation markers under different conditions.

Preventing, detecting and treating neurological disease

Clinical indicators and predictors of cognitive decline

The Dementia Prevention Research Clinics (DPRCs) are a flagship enterprise for BRNZ, and the recruitment of participants has been building nicely across the three sites in Auckland, Christchurch and Dunedin. The value of this unique longitudinal study is highlighted by the fact that at least 16 quality projects are now underway and involving the DPRC resources. The primary aim at this early stage of cognitive decline is to identify clinical indicators and predictors of cognitive decline during ageing. It is exciting to see such a high level of energy directed to this initiative, not to mention the new and continuing collaborations between researchers across our university partners. These projects are intensively addressing predictors such as blood "biomarkers" (e.g. specific proteins or RNA), structural and functional changes in the brain as identified by MRI and PET scans, and clinical neuropsychological data that may be able to help create a "fingerprint" by which to identify those individuals likely to decline towards dementia, rather than progress through normal ageing processes.

Promoting recovery after brain injury

Some brain injuries are particularly prevalent during ageing, and stroke is probably the most common example. BRNZ is fortunate to have top quality stroke researchers and clinicians as part of its team. Prof Valery Feigin and A/Prof Rita Krishnamurthi have completed a study of community knowledge and stroke awareness amongst 400 New Zealanders of various ethnicities (published in *Jo Stroke Cerebrovascular Disease*). One finding was that few people knew that stroke was a major cause of death, or its key risk factors, unless prompted. These findings have motivated the same researchers to develop an app aiming to increase stroke awareness and reduce stroke risk, with very promising results from a pilot randomised trial (*Stroke*). Post-stroke, an amazing improvement in clinical care has arisen from the development of new clot-removal methods, driven by research contributed to by Prof Alan Barber (*J Neurointerventional Surgery*). For those not rescued by surgery, a blood biomarker has been developed by A/Prof Jian Guan that may be able to predict stroke recovery outcomes (*Annals Clinical Translational Neurology*). And new treatment ideas are being intensively investigated, such as a novel brain stimulation technique by Prof John Reynolds (*Experimental Neurology*), arm support methods for improving upper limb dysfunction by Prof Byblow (*Experimental Brain Research*), and novel drugs and natural chemicals as pharmacological agents for improving stroke recovery by A/Prof Andrew Clarkson (*Frontiers Neuroscience; J Cerebral Blood Flow Metabolism*).

Testing treatments for ageing and disease-related dysfunction

Other researchers are focusing on new treatment strategies for Alzheimer's disease and related dementias using animal models. Prof Wickliffe Abraham, A/Prof Joanna Williams and Prof Warren Tate have uncovered some of the molecular mechanisms by which a therapeutic protein (secreted amyloid precursor protein-alpha, sAPPα) works to enhance the brain's memory mechanisms (*J Neuroscience*). Prof Abraham, Prof Tate and A/Prof Stephanie Hughes have gone on to show that small peptide fragments of the sAPPα protein are sufficient in themselves to enhance brain plasticity and ameliorate the deficits in plasticity found to be incurred by disease-related protein aggregates (*Frontiers Molecular Neuroscience; Neuropharmacology*). These small active peptides have a higher potential of being translated into a useful therapeutic in humans to enhance the brain's resilience against disease pathology. In a different strategy for Alzheimer's, A/Prof Ping Liu has tested the safety and chemical profiles of a novel therapeutic drug, agmatine, which can potentially be repurposed for use given that it is already commercially available (*Scientific Reports*). Finally, it appears possible that targeting the neuroinflammation that accompanies Alzheimer's neuropathology could be a useful strategy, as an antibody against an inflammatory protein was shown by Prof Abraham's group to be able to restore memory-related brain plasticity in an Alzheimer's model (*J Neuroscience*), an approach already successful for treating the peripheral inflammatory disorder, rheumatoid arthritis.

Assessing sensory system decline in the Dunedin study

When we consider the factors contributing to cognitive decline, either during normal ageing or as a result of dementia, researchers have typically focused on genetics, accumulated lifestyle factors or frank disease pathology as the main drivers of the effect. Recently, however, it has become apparent that ageing-related impairments in sensory function play a much bigger role than anticipated, as reviewed by Prof Peter Thorne and A/Prof Srdjan Vlajkovic (*J Neuroscience Cognitive Studies*). Hearing loss may increase the workload of the brain to compensate, which could be damaging ultimately, but such loss may also lead to social isolation and depression, known risk factors for cognitive decline. Prof Thorne and Prof Suzanne Purdy are investigating these links via the Phase 45 data collected by the Dunedin longitudinal study (led by Prof Richie Poulton). Initial findings are that there has been a significant overall decline in hearing ability over time since age 13, and they are currently looking at the relationship between hearing ability and other measures of ageing, cognition, mental health and oral health.

This work is being complemented by studies with Prof Thorne and Prof Abraham using a mouse model of Alzheimer's, which exhibits a natural hearing loss on top of the disease pathology.

Sensory interventions to reduce ageing-related neurological decline

Based on the above, it would be natural to think that improving hearing ability, for example, might help slow cognitive decline, which is one reason for actively promoting the use of hearing aids amongst the elderly. But sound therapy may also be helpful for the treatment of tinnitus, one of the most common neurological ailments amongst the elderly. A/Prof Grant Searchfield has shown that playing an ocean sound with or without an additional regularly varying sound may have some promise in producing a short-term reduction in tinnitus perception (*Complementary Therapies Medicine*). Other nature sounds can also elicit this effect, as can broadband noise which has the added benefit of reducing blood pressure (*Complementary Therapies Medicine*). Findings from these and other studies have helped A/Prof Searchfield and colleagues develop a person-centred approach to treating tinnitus (*Disability Rehabilitation*) that is now being used in his hearing clinic.

Improving clinical practice

Therapeutic interventions in the clinics and community

While many of our BRNZ researchers are working away in their laboratories to develop or improve disease biomarkers and therapies, what we do out in the community to try and help people now is equally important. A good example is the study underway using some of the DPRC participants to determine whether a combination of vestibular stimulation and balance training, repeated many times, can improve cognition or slow its decline. This study is detailed elsewhere in this report.

In a different approach, psychogeriatrician Dr Gary Cheung has been actively testing and promoting a form of therapy for cognitive decline, termed cognitive stimulation therapy (CST). Although CST has been shown to have some benefit on cognition and quality of life, getting staff at rest homes with CST training to continue implementing CST over time can be challenging due in many cases to a lack of support, a facet of the program that Dr Cheung is actively working on improving (*Australasian Psychiatry*).

Of growing interest these days are multicomponent treatment regimes to improve cognition. However, our researchers have shown that caution is warranted, as a recent meta-analysis of combined cognitive and physical interventions for people living in the community with mild cognitive impairment, undertaken by Prof Ngaire Kerse and A/Prof Lynette Tippett, was unable detect a clear effect across six studies using such a combined intervention (*American Journal of Lifestyle Medicine*). Recommendations to improve future interventions were put forward however, and Prof Kerse is undertaking one such trial currently. Prof Kerse is also involved in a completely different project, aiming to develop home-based healthcare robots to support people with mild cognitive impairment and dementia (*Geriatric Medicine*).

Even for normal, healthy ageing individuals, interventions or lifestyle changes have the potential to slow ageing-related cognitive and physical decline. For example, Prof Cathy Stinear has shown that both poi and Tai Chi can improve upper limb strength and range of motion, along with memory in older adults. Poi also had a positive effect on systolic blood pressure (*J Aging Physical Activity*). Likewise, A/Prof Liana Machado and colleagues have shown a benefit of swimming on cerebrovascular function and cognition in young adults, leading to the prospect that this may be helpful for older adults as well (*Physiological Reports*). Already A/Prof Machado is exploring the links between physical activity, cerebrovascular function and cognition in aged participants (*Neuropsychologia*). On top of these experimental studies, observational life-course studies such as the Dunedin study are providing a wealth of data on life-course factors affecting the rate of ageing. Appropriately done, life-course studies could equally provide completely novel information about factors affecting ageing and well-being specifically for Māori, as aspired to by Dr Reremoana Theodore and colleagues (*J Indigenous Wellbeing*).

Improving accessibility to services

There are many challenges when considering how to assess cognition and dementia in different ethnic groups, and in New Zealand this is an especially pertinent consideration for Māori. Dr Makarena Dudley, together with Dr Hinemoa Elder and other colleagues, has investigated through many conversations and focus groups how Māori perceive "mate wareware" (being unwell and forgetfulness). From this work it became clear that whānau play a key role in supporting and protecting kaumatua with cognitive decline, while revealing the need for all to have more information and to become empowered (*NZ Medical J*). Alongside this study, Dr Dudley has been developing culturally appropriate tests of cognition for Māori, having revealed a variety of factors that can negatively influence performance by Māori on standard cognitive tests (*Archives Clinical Neuropsychology*). This conclusion was supported by a complementary study by Prof Kerse, A/Prof Tippett, Dr Cheung and Dr Phil Wood (*Alzheimer's Dementia*). These issues may flow on to the (un) willingness of Māori or other ethnic groups to be diagnosed and to access health services.

Further to the issue of access to health services, in this case hearing clinical services, Prof Thorne and colleagues have revealed a host of factors contributing to the more limited access to such by older Pacific people, including key elements such as financial cost, structural factors (transportation, lack of hearing services in community practices), and cognitive barriers such as lack of awareness of such services (*British Medical J Open*).

Another issue related to health services is the quality of the services themselves, and a less well understood aspect of this is the quality of service of aged care support workers. This quality is very likely dependent on the felt worth of these workers, and research by Prof Leith Hale, Prof Pauline Norris and Prof Nicola Kayes has revealed that the self-worth is very dependent on the quality of interpersonal interactions between the workers, their employers, the patients' families and their peers (*Ageing Society*). Their work has led to recommendations such as managers being more willing to listen to, and give autonomy to their staff, and for managers to make their workers' skills and attributes better known to their employers, clients and co-workers.

The Dementia Prevention Research Clinics

FOR BRNZ's national network of Dementia Prevention Research Clinics (DPRCs), 2019 was another exciting year. Led by national DPRC Director, Associate Professor Lynette Tippett, the clinics' primary aim is to recruit and study ~400 people with mild cognitive impairment (MCI) or the earliest stages of Alzheimer's, to determine which biomarkers, cognitive characteristics, and health and lifestyle factors influence the development and progression of Alzheimer's disease (AD).

In 2019 our participant numbers continued to climb in each of our Auckland, Dunedin, and Christchurch clinics, providing opportunities for a wide range of New Zealanders to be part of our research. With the advice and support of our exceptional Māori advisors, we are working to recruit Māori and members of minority ethnic groups.

By the end of the year, 275 individuals had undergone the initial clinical assessment, while 228 study participants had completed all components of the assessment. In an exciting development this year, we began incorporating amyloid PET scanning in the assessment process. By visualising plaques present in the brain – prime suspects in damaging and killing nerve cells in AD - these scans are a vital addition for the effective characterisation of our participants' brain health.

Critically for a longitudinal study, the DPRCs' retention rates are excellent, testament to the calibre of our clinical research teams, the value we place on manaakitanga - looking after participants - and the value participants and their whānau derive from being part of the study. For individuals with MCI (and their whānau) in particular, engagement in the DPRCs provides a high-quality annual assessment with skilled clinicians and the chance to talk about the issues they are grappling with in everyday life.

DPRC research projects ramp up

Study members also have opportunities to take part in a range of studies that further our understanding of MCI and early AD, and the experience of individuals and their whānau members. They may also be invited to participate in preliminary clinical trials, with the goal of identifying treatments and interventions that might prevent, delay, or ameliorate Alzheimer's disease. The 16 studies we have running range from identifying blood-based biomarkers, MRI-based biomarkers, the development of novel MRI sequences that may detect early changes, and EEG biomarkers, through to the development of sensory-based interventions, and the evaluation of factors associated with positive well-being and quality of life. Interestingly, in preliminary analyses our data show that DPRC participants report higher levels of well-being than reported in other MCI studies or community samples, which suggests positive benefits just from engaging in the DPRCs.

By far the most exciting development this year for participants, was the start of our first intervention study, which is being piloted with Auckland clinic participants by Professors Denise Taylor and Paul Smith. Neurologist Dr Nick Cutfield will begin a second pilot double-blind randomised control trial involving Dunedin DPRC participants next year.

Christchurch DRPC opens its doors

On Friday 26 July, we were delighted to see our Christchurch DPRC - the third in our national network of clinics - formally open its doors to the public. The clinic, based at the New Zealand Brain Research Institute, was officially opened by Christchurch Mayoress Lianne Dalziel, who was joined by an impressive line-up of speakers including Sir Eion Edgar, DPRC participant Brother Osmund, Sir Tipene O'Regan (Ngāi Tahu), Rangihau Te Moana (Tuhoe) and University of Canterbury Deputy Vice-Chancellor Professor Ian Wright and just under a hundred guests.

Led by Profs Tim Anderson and John Dalrymple-Alford, the Christchurch clinic provides a long-awaited avenue for Cantabrians to be part of a national effort to better understand the risk factors and progression of AD that aims to develop new treatments that may mitigate cognitive decline.

People and partnership – at the heart of quality research

The Auckland DPRC ran its third annual "DPRC event" in September, which is for the participants and whānau. This was enormously popular, with more than 110 attendees braving Auckland's early spring weather and the evening rush hour traffic. As well as providing updates on current studies, much of the session was open to the floor for questions for our panel, comprising our entire clinical team. Lively interactions, thoughtful and tricky questions, respect, and a strong sense of community infused the evening. This event highlighted the critical essence of the DPRCs: First and foremost, they are about the people, about reciprocity and meaningful partnership.

LEFT:
Associate Professor Lynette Tippett, BRNZ Associate Director, National Director of the Dementia Prevention Research Clinics.

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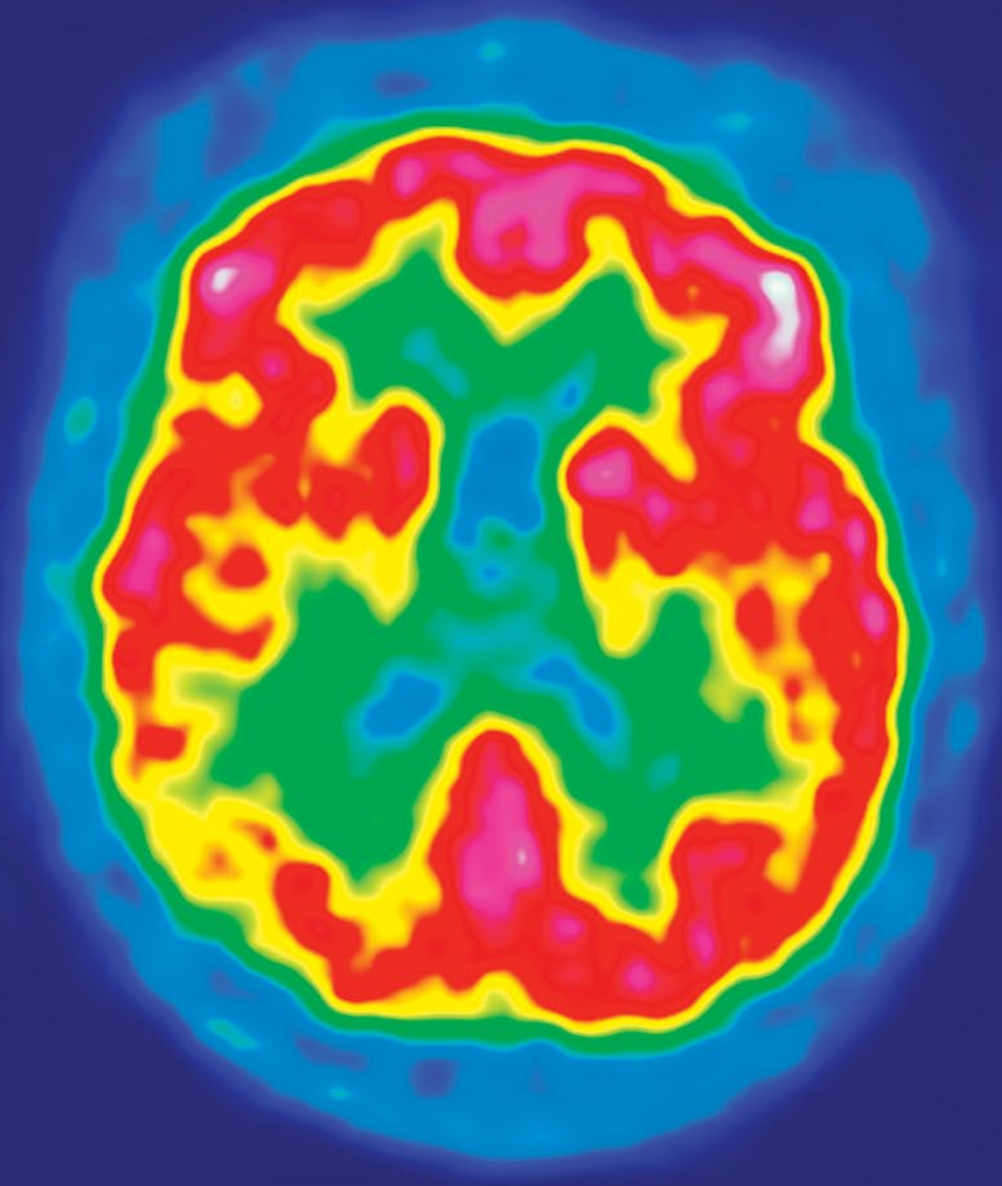

IMAGE:
Positron emission tomography (PET) scan of the brain of a person with Alzheimer's disease. The colour-coded scan shows metabolic activity throughout this axial section, from low (blue) to high (red, pink and white). PET scanning utilises an injected radioactive tracer to reveal variations in metabolic activity in the brain. A normal scan would reveal a more symmetrical pattern of high activity across the cerebral.

The New Zealand Dementia Prevention Trust

WHEN BRNZ launched its first Dementia Prevention Research Clinic in Auckland three years ago, the New Zealand Dementia Prevention Trust (NZDPT) was busy launching its own campaign - to raise $10 million in philanthropic funding to support the clinics' research goals.

Fast forward a few short years, and the NZDPT is nearing the halfway mark with $4.4 million coming from 31 generous donors. This level of philanthropy is exceptional for a CoRE and our gratitude to founder and Chair, Sir Eion Edgar, and all those who have donated to the Trust is immeasurable. In 2019 major donors included the Aotearoa Foundation, the Angus Trust and the Lion Foundation, the latter donating $150,000 that helped us to fund the MRI scanning of Auckland-based study participants and employ a full-time blood bank technician and Clinic Co-ordinator. As one of the oldest and most respected Charitable Trusts in New Zealand, the Lion Foundation is known to support thousands of good causes across the country and BRNZ is grateful that it is adding in such an important way to the fundraising efforts of the NZDPT.

"This level of philanthropy is exceptional for a CoRE and our gratitude to founder and Chair, Sir Eion Edgar, and all those who have donated to the Trust is immeasurable."

The New Zealand Dementia Prevention Trust's success in supporting the clinics has enabled us to broaden our investment in other invaluable initiatives, such as building critical research infrastructure and helping an increased number of postgraduate students and postdoctoral fellows further their promising careers.

THANK YOU!

to our donors

Aaron Smith
Alan Gibbs
Alzheimers New Zealand Charitable Trust
Angus Trust
Aotearoa Foundation
Burrows Brothers Charitable Trust
Callis Trust
Christopher Barnes
D Follas
Dr Youngming Fu
David Levene Foundation
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Ralph & Pam Norris
Robert & Barbara Stewart Charitable Trust
Sir Eion & Lady Jan Edgar Charitable Trust
Sir Ralph & Lady Pam Norris
Taranaki Aviation Transport & Technology Museum
Woolf Fisher Trust

TOP:
Christchurch Dementia Prevention Clinic Co-Directors, Professor Tim Anderson (University of Otago, Christchurch) and Professor John Dalrymple-Alford (University of Canterbury).

ABOVE RIGHT:
New Zealand Dementia Prevention Trustees, Sir Eion Edgar (Founder and Chair), Lady Barbara Stewart, Mr Bill Moran and Sir Don McKinnon at the launch of the Christchurch Dementia Prevention Research Clinic.

Challenging the brain and body in the search for effective therapies

YOU may not realise it, but finding your way around your environment is a very complex process; one that relies on multiple sensory systems and a variety of cognitive skills. Your ability to balance, enabled by the vestibular system in your inner ear, combines with your visual perception, learning and memory skills, to help build a mental map of your surroundings. But many people living with mild cognitive impairment (MCI) experience difficulties in spatial navigation, as well as in their physical movement. For BRNZ Principal Investigator, Prof Denise Taylor, the connection between the vestibular system, balance and cognition may offer a potential route to therapies that promotes optimal functioning in people with MCI.

"Spatial navigation in the real world draws on the integration of gait, balance and cognitive abilities," says Denise, a Professor of Clinical Sciences at AUT. *"But to date, rehabilitation approaches haven't recognised that, and instead treat symptoms in isolation from one another."* This is a situation that Denise is now working to change, thanks to a BRNZ-funded pilot study that she is leading.

It features a technique called noisy galvanic vestibular stimulation (nGVS), which involves passing a small electrical signal into the vestibular system via an electrode placed behind each ear. *"The stimulation is below the sensory threshold, which means that people can't feel it,"* explains Denise. *"We then lay a white noise signal on top of it, which helps to boost the otherwise weak signal that travels from the vestibular system to the brain."*

There is a small but growing body of research that suggests nGVS can improve balance and gait in humans; most of the previous work on spatial memory was carried out in mice. Luckily, Denise is joined in this project by two other BRNZ Investigators – Prof Paul Smith and Associate Professor Yiwen Zheng, both from the University of Otago. As Denise explains, *"Paul and Yiwen have established a lot of our understanding on the links between the vestibular system and various parts of the brain in animal models. For example, there's evidence to show that individuals with vestibular disorders have smaller volumes in the hippocampus, which is a very busy part of the brain in spatial navigation tasks."*

For Denise, working in large, diverse teams is one of the best aspects of BRNZ research. *"Having the ability to call in expertise from different clinical areas and labs is brilliant. It makes working on a challenging research question even more exciting!"* Alongside Paul and Yiwen, Denise is collaborating with her AUT colleague, Dr Sue Lord, as well as BRNZ Principal Investigator Associate Professor Lynette Tippett. Denise says, *"Our focus is on creating a therapeutic intervention for people with amnesic MCI, which means we need to recruit suitable participants. We couldn't do that without Lynette and the Auckland Dementia Prevention Research Clinic (DPRC). They have the best diagnostic tools, and a cohort of willing volunteers."*

Participants in the pilot study travel to one of several locations across Auckland twice a week for eight weeks. In each session, they wear the nGVS electrodes while undertaking a series of complex physical tasks. *"We're trying to challenge the vestibular system in particular,"* explains Denise. *"So not only are we hitting it with electrical stimulation, we're throwing balance-related demands at it at the same time."*

The study will use a variety of tools to look for improvements in balance, gait and spatial navigation. For balance, force plates and 3D motion analysis will look for particular characteristics of postural sway. During walking tasks, stride length and width will also be monitored. *"The participants are reasonably good at balance tasks, so we expect these changes to be fairly subtle,"* says Denise. *"The biggest challenge with measuring spatial navigation is that we don't actually have reliable metrics that apply when a person is moving."*

Denise is running a separate pilot study to test the reliability of a series of potential spatial navigation tests. They include the Triangle Completion Task, where participants try to complete the arms of a triangle with their eyes closed, and the Floor Maze Test which evaluates cognitive functions like spatial perception and episodic memory. She says, *"The key thing for us is that participants are moving while undergoing nGVS. When you're sitting still, you shouldn't have a lot of stimulus to your vestibular system – we want to apply the galvanic stimulation only when the system should be firing anyway. We expect our intervention to be a lot more effective and more specific that way."*

Denise continues, *"This study has been vital in helping us to work out the practicalities of the method, and in further expanding our knowledge of spatial navigation."* In the long term, the hope is that this combination of cognitive and physical tasks and vestibular stimulation may become a truly practical rehabilitation programme for people with MCI.

"We're trying to challenge the vestibular system in particular. So not only are we hitting it with electrical stimulation, we're throwing balance-related demands at it at the same time."

PROFESSOR DENISE TAYLOR

Providing a therapy to live well with dementia

***"THE** first time I came across Cognitive Stimulation Therapy (CST) in a research report, I just thought 'wow',"* says BRNZ Principal Investigator Dr Gary Cheung. *"Here was this evidence-based treatment that could benefit my patients living with dementia, and yet I hadn't heard of it being delivered here in NZ. I had to learn more."* Reading that paper set Gary, an old age psychiatrist and clinical researcher at the University of Auckland, on a new path. Today, he and his colleague, Dr Kathy Peri, are NZ's foremost experts on CST and their work is making a difference across the country.

"Cognitive Stimulation Therapy takes a slightly different angle – it isn't about preventing dementia, and there's no medication involved," explains Gary. *"It offers a way for people to live well with dementia. It helps to improve their quality of life."* First developed by psychology and psychiatry researchers at University College London, CST is delivered to small groups of participants – usually six to eight – over 14 sessions (twice a week for seven weeks). In each session, facilitators use activities, discussions, and social interactions to actively stimulate and engage people who've been diagnosed with mild to moderate dementia. Trials on CST in different parts of the world have shown that the treatment can improve participants' cognition and language skills, as well as their quality of life.

Since undergoing their own training back in 2015, Gary and Kathy haven't just used it to shape their own research, they've also trained other health professionals to deliver CST across Australia and New Zealand. *"The total figure is about 400, I think,"* says Gary. *"A lot of that was enabled by BRNZ, who funded us to hold ten training workshops across NZ in 2018."* But, he says, learning the skills is only step one: *"The biggest challenge has been implementing the therapy when everyone is struggling for resources. For example, Dementia Auckland, Dementia Wellington, Alzheimer's Manawatu and Enliven have been fantastic – they now run CST groups throughout the year. Our next goal is to do a cost-effectiveness study for CST here in New Zealand, and we hope that'll lead to funding from more District Health Boards."*

Gary and Kathy are now running a BRNZ-funded research project that will add another dimension to CST practice here in NZ – and it involves chair yoga. He says, *"Professor Aimee Spector, who developed the key principles of CST in the nineties, told us that back then, there was little research on physical activity and cognitive impairment. Now, we have a lot more evidence of the positive effects of exercise and meditative practice."* The current study, in collaboration with Prof Marla Berg-Weger at St Louis University in the US, is working with participants from three Selwyn Foundation retirement villages in Auckland. One group is undertaking a course of CST, while another is learning chair yoga. The third group receives both CST and chair yoga. *"The idea is to compare each of the three arms of the study, to understand if there's any benefit to delivering both interventions to people with dementia,"* explains Gary. He and Kathy have worked with the Selwyn Foundation previously, and he says that while they haven't yet analysed the results, initial feedback from facilitators has been positive. *"We hope that this will give us some NZ-specific data that we can then use to launch a larger study."*

An important complement to this work is the BRNZ research that the duo now doing in collaboration with Māori neuropsychologist Dr Makarena Dudley, and Tongan-born psychiatry registrar Dr Staverton (Tony) Kautoke. *"CST was initially developed in the UK, so it lacked Māori and Pasifika cultural content and values,"* says Gary, *"But, population ageing is happening faster in those groups than in Pākehā New Zealanders, so we know that issues of dementia and cognitive decline will become increasingly relevant to them."* Over the years, CST has been successfully adapted for use in countries as diverse as Japan, Denmark, and Tanzania, but the BRNZ team are taking a novel approach to culturally adapting CST. Working with groups in Whakatāne and Wellington, they are examining all of CST's key principles. *"For example, every one of the eighteen principles is now embedded in kaupapa Māori, which gives its meaning a true richness. This is a huge step forward in ensuring the treatments works as well as it possibly can for everyone."* Gary continues, *"It's a really exciting project, and I'm exceptionally grateful to our collaborators and the cultural experts, led by Amohaere Tangitu of Ngāti Awa."*

"...back then, there was little research on physical activity and cognitive impairment. Now, we have a lot more evidence of the positive effects of exercise and meditative practice."

ABOVE LEFT:
BRNZ old age psychiatrist, Dr Gary Cheung.

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Quality means ...

EXCEPTIONAL BREADTH AND DEPTH OF TRAINING

to ensure our students develop the diverse skills and networks they need to succeed, whatever their chosen field.

As a CoRE, Brain Research New Zealand, recognises the important part we play in developing the next generation of scientists, researchers, clinicians and policy makers, to improve the health and wellbeing of our ageing population. In 2019, we continued to deliver an outstanding training programme, providing scholarships, face-to-face training experiences, and research and leadership mentoring to produce a well-rounded well-trained workforce for the future of New Zealand.

ABOVE:
Professor John Reynolds, Associate Director of Leadership Development and Capability Building.

Training the brightest minds

EVERY year, BRNZ trains the brightest minds through a broad range of PhD scholarships, postdoctoral fellowships and summer studentships including some specifically for Māori and Pacific students. We also offer an MBChB-PhD programme, which, alongside extensive clinical training opportunities, help to advance translational research.

To date, 352 students have been involved in our research programme, with BRNZ directly funding 25 PhD students (three Māori), 9 postdoctoral fellows (one Māori), 15 Māori and three Pacific Summer Scholars and 2 Māori Masters students. Trainee clinicians - 28 in total - have also developed research skills through the CoRE including an impressive line-up of doctors, surgeons, psychologists, physiotherapists and audiologists to boot.

While BRNZ's hive of talented young neuroscientists is our greatest strength, we understand that not all of these researchers will pursue a career in academia. And that even if they do, they will need much more than knowledge of the latest research to achieve success. It is for this reason, that we invest heavily in a world-class training programme that delivers the breadth and depth of training our early career researchers (ECRs) need to excel: from working with leading investigators at the intersection between fields, to grant-writing, networking, cultural competency, and communicating science, BRNZ provides the training and leadership opportunities that make our ECRs stand out, whatever their chosen field.

The whole world in their hands

THIS year, BRNZ's Young Ambassadors Scheme saw us fund 37 ECRs who set off for conferences, training courses and laboratory visits across the world. In a fast-moving field like Neuroscience, ECRs need to be given the chance to access new trends and to gain hands-on experience in the latest techniques. Making an impression is also important, with international conferences providing an ideal way for ECRs to meet world-class scientists, to hone their presentation skills and to build professional networks. Take Sophie Mathiesen's experience of the Society for Neuroscience (SfN) meeting in Chicago, for example. One of BRNZ's Māori PhD scholars, Sophie is investigating how modifications made to viruses used in gene therapy can improve the virus's efficiency at getting into the central nervous system, key for the success of gene therapy treatments. After submitting an abstract to the SfN meeting with hopes of presenting a poster, Sophie learnt that her abstract was one of *fifty* selected from 14,000 to be covered at an international press conference. Sophie's presentation, delivered alongside four other researchers - all very senior, and all from the United States –was a success, marking her arrival on the international stage, with the promise of great things to come.

"I would like to see a community of research leaders, well-versed in the language of leadership, prepared to step up to mentoring and supporting others to achieve their best."

PROFESSOR JOHN REYNOLDS

Early Career Researcher Workshop 2020

ON March 8 2019, 75 early career neuroscientists attended BRNZ's 4th ECR workshop. Held in Auckland, we scheduled the workshop a day prior to our national conference, to give ECRs the chance to enjoy three full days of training, research and community events. As keynote speaker at the workshop, Prof Juliet Gerard was first up and a firm favourite with the group. Chief Science Advisor to the Prime Minister, she kept everyone enthralled with lessons in what not to do from her career in science. *"If you can't be a good example, then you'll just have to be a horrible warning"* was Juilet's take-home message, which she delivered alongside practical advice and amusing anecdotes from her formidable career. Following Juliet's talk, we ran a lively speed dating session to give everyone the opportunity to practise their networking – a critical skill in science – and to meet peers from across the CoRE. The second half of the workshop saw A/Prof Jesse Bering, Director of the University of Otago's Centre for Science Communication, take the stage to teach our ECRs how to bring their science to life through stories. Deftly using the final episode of *The Sopranos* as an example of how to craft a cliff-hanger, Jesse's lessons in story-telling were entertaining and went a long way in empowering our ECRs to give voice to their work. Following Jesse, Prof John Reynolds brought the workshop to a close with an interactive session on leadership, lollipop moments, and learning to be brave.

As BRNZ's Associate Director of Leadership Development and Capability Building, John has been the driving force behind BRNZ's development programme, working with our Early Career Advisory Group to deliver a practical and inspiring training programme year after year. Speaking of what he'd like BRNZ's legacy to be, John says *"I would like to see a community of research leaders, well-versed in the language of leadership, prepared to step up to mentoring and supporting others to achieve their best."* He continues *"I would like to see their influence transcend institutional and disciplinary boundaries"*. Based on feedback from our workshop participants – always very positive - it would seem BRNZ's training programme is on track to deliver just that.

Beyond leadership and skill development, BRNZ's ECR workshops give emerging researchers the opportunity to connect and build collaborations with peers across the country - something we're told they value most. And it's this feeling – of community and connectivity among our budding neuroscientists– that is the true indicator of success, as New Zealand's science culture of tomorrow takes shape.

LEFT:
Professor Juliet Gerard, Chief Science Advisor to the Prime Minister, gives career advice to BRNZ's ECRs.

Clinician-Scientists: bridging science and medicine

THROUGH BRNZ's MBChB-PhD programme, we aim to expand the base of clinician-scientists able to apply our physical and social science discoveries to improve the health and wellbeing of the individuals they meet in clinical practice. The students in the programme benefit by taking two additional years out of their busy medical training to develop advanced research skills, culminating in obtaining an internationally recognised PhD qualification. By way of example, two of our Dunedin-based students have recently completed their theses: Tim Galt investigated the application of advanced biofeedback of EEG waveforms to improve memory impairment and Rosie Melchers applied novel stimulation patterns to the brain to improve recovery of movement after stroke. In this way, we aim to advance translational research and roll out our discoveries to better treat disorders of the ageing brain.

Māori and Pacific Summer Scholarships

This year BRNZ was proud to welcome six Māori and three Pacific Summer Research Scholars into our laboratories and clinics, where, for ten weeks over summer, they had the chance to conduct hands-on biomedical research with senior investigators. Recruiting increasing numbers of Māori and Pacific students into the educational pipeline is crucial for our CoRE; not only will it influence the numbers of Māori and Pacific peoples in science and healthcare in years to come, but it also helps us to improve the cultural competency of our workforce, and to carry out culturally appropriate research in areas of need.

Here we introduce you to BRNZ's latest "ones to watch" who join our expanding team:

Grace Heays
(Ngāi Tūhoe, Ngāti Awa)

Grace is working with Prof Suzanne Purdy (University of Auckland) on a project developing a community peer support system for and with Māori stroke survivors and their whānau in the Eastern Bay of Plenty.

Isaac Samuels *(Tainui)*

Supervised by neurologist Prof Alan Barber (University of Auckland), Isaac, a medical student, is looking at the long-term effects of endovascular clot retrieval on Māori and Pacific stroke patients. Isaac aims to identify all Māori and Pacific people treated with ECR in 2018 and 2019, and analyse their analysing treatment rates and outcomes compared to other ethnic groups, to determine whether ECR is provided in an equitable manner in New Zealand.

Jasmyn Williams
(Ngāi Tahu, Ngāti Tūwharetoa, Uenuku, Ngāti Apa, Ngāti Rangi)

Jasmyn, who was first awarded a BRNZ Māori Summer Scholarship in 2018, is returning this year to continue her work with Dr Tracy Melzer (University of Otago, Christchurch) on a project using diffusion tensor imaging (DTI) to investigate the integrity of the corpus callosum as a marker of cognitive decline in Parkinson's disease.

Maddison Moore
(Ngāi Tahu, Ngāti Kahungunu)

Maddision, supervised by Prof John Dalrymple-Alford (University of Canterbury), is investigating the suitability of CogTrack, an internet-based assessment of cognitive function, for older Māori. In their initial work, they aim to explore the response and potential uptake by older Māori.

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Te Waka Smit
(Ngāti Porou)

Te Waka is working with Prof Nicola Kayes (Auckland University of Technology) to build a culturally responsive sensory experience for Māori with dementia, which aims to improve mood, behaviour and well-being.

Jordan Quensell

Under the supervision of A/Prof Liana Machado, Jordan is looking at the effect of high-intensity-interval-training, in this case stair-climbing, on mood and cognitive performance in older adults. His research indicates that stair-climbing improves aspects of cognition and mood, and could act as an intervention to improve the wellbeing of older adults.

Tori Diamond
(Ngāpuhi)

Tori is working on a research project led by Dr Makarena Dudley (University of Auckland), which aims to understand dementia from a Māori world-view and to develop a Māori-responsive assessment tool for the diagnosis of dementia. Tori is supporting the project through data collection and analysis of the developed tool, the Māori Assessment of Neuropsychological Abilities (MANA) tool.

Lolomani Kalauta

Lolomani (Tongan) is working with Dr Sarah Cullum to investigate whether Māori and Pacific families living with dementia have increased economic burden compared to Pākehā families. Using data from Counties Manukau DHB, she is looking into the social and health care costs of dementia care, and analysing possible inequities.

Ileana Lameta

Ileana is working with Prof Pauline Norris and A/Prof Rosalina Richards to explore the needs of Pacific families affected by age-related cognitive impairment and how mainstream providers interact with Pacific families. Because Pacific people are diagnosed with dementia at a younger age and a more advanced stage, Ileana is interested to see how engaging existing mainstream dementia resources are to a Pacific audience and how Pacific tools such as Yavu and Kapasa could be used to assist dementia support providers to more effectively engage with Pacific families.

Thinking beyond the booth

UNTREATED hearing loss – a risk factor for cognitive decline – is a growing epidemic: The number of older New Zealanders suffering from hearing loss is predicted to double in the next 50 years. For Māori, the situation is particularly concerning: While they have a higher prevalence of hearing loss, they are under-represented in ACC claims for hearing loss. And in 2018, Māori made up only 2% of the DHB audiologist workforce, far below the 16% Māori in our population.

Alehandrea Manuel first looked into the disparities in our hearing services with Māori and Pacific populations during a summer studentship with Assoc Prof Grant Searchfield. She further specialised in the field of hearing healthcare for indigenous peoples during a stint in Australia, where she completed a MA of Audiology and worked as an audiologist at Townsville Hospital. Working with Torres Strait Island and Aboriginal populations, Alehandrea and her team provided culturally appropriate care and liaised with community group leaders and health workers. “Engaging with the indigenous communities showed me where audiology services can improve,” she says, for example by providing tele-audiology, effectively reporting results to families, and gathering normative data for indigenous populations.

Equipped with these learnings, Alehandrea felt the urge to come back to New Zealand to tackle the disparities there, and do things for her own people. She was awarded a Māori PhD scholarship from BRNZ, supervised by Assoc Prof Grant Searchfield and Assoc Prof Elana Curtis.

For her project, she is looking at how older Māori and whānau experience hearing loss and hearing services in New Zealand. She is accompanying study participants to audiology appointments and is conducting interviews with participants and whānau. “I’m hoping we can get a better gauge of what we’re currently doing wrong and what we’re doing right within our system. I want to help facilitate a transformational change of our services.”

She has also held hui with Māori healthcare providers who assist kaumātua and kuia with their day to day lives. They have been very eager to help improve their elders’ hearing health, she reports, as they recognise it as a way to assist with the patient’s communication with their whānau, hapū and iwi, and enables them to continue their various roles in society.

Building relationships with people as research partners is central to Alehandrea’s endeavour. “For most of my clinical career, I’ve been stuck in a soundproof booth”, she says. “However, this PhD journey and the kaupapa have given me a lot more confidence to get out in the community, learn how to build and maintain relationships, have conversations, and listen to our koroua, kuia, and their whānau stories.”

In the end, Alehandrea always comes back to the people. Helping them is what keeps her motivated, “and knowing that my work has the potential to change hearing services for Māori”

“I’m hoping we can get a better gauge of what we’re currently doing wrong and what we’re doing right within our system. I want to help facilitate a transformational change of our services.”

ALEHANDREA MANUEL

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Quality means ...

RESEARCH THAT IS BY MĀORI, FOR MĀORI

and informed by mātauranga; where Māori communities feel heard and set their own agenda.

For BRNZ, the pathway to improving Māori health and wellbeing during ageing begins with partnership. To be successful, we need to build equal and meaningful partnerships, fund kaupapa Māori research, and support Māori in developing the skills they need to determine their own pathways to brain health. Improving our cultural competency is important too, to provide a safe environment for Māori researchers, and genuinely competent health and research services for our Māori population. In 2019 we worked hard to bring our Māori engagement strategy to fruition – a few key highlights are set out below.

Mātauranga Māori research platform

IN 2017, BRNZ invested in a mātauranga Māori research platform to help us incorporate mātauranga Māori across the CoRE. The platform is led by Dr Hinemoa Elder (Māori Strategic Leader, Ngāti Kurī, Te Aupouri, Te Rarawa, Ngāpuhi) and Prof Nicola Kayes (AUT) and A/Prof Anne Marie Jackson (Ngāti Whātua, Te Roroa, Ngāpuhi, Ngāti Wai me Ngāti Kahu o Whangaroa), and has three key goals: to provide mātauranga across BRNZ to improve our research and clinical methods; to build relationships with Māori communities to support their engagement in our research; and to provide career development opportunities, for both Māori and non-Māori to experience mātauranga in practice.

In the two years it has been running, our Mātauranga platform has gone from strength-to-strength - a credit to both its research assistant Chelsea Cunningham (Ngāti Kahungunu, PhD Candidate, Otago University) and the team of lead investigators. BRNZ now has Māori researchers at the helm of eight kaupapa Māori studies, we have directly funded the training of 23 Māori emerging researchers, and 64 BRNZ investigators and early career researchers have participated in Takarangi Cultural Competency training through the CoRE.

It is hard to single out specific achievements from 2019, but mention has to be given to our first Mātauranga PhD student, Justine Camp (Kai Tahu), and Master's student, Ben Hanara (Ngāti Kahungunu), who completed their degree programmes this year. We are also excited to see two community-based Māori projects nearing completion, led by A/Prof Louise Parr Brownlie and Prof Nicola Kayes. Louise is working with Puketeraki marae to investigate Māori views of neurostimulation technology for treating neurological conditions, while Nicola and her team are working with Hoani Waititi marae to understand what matters most to Māori in the therapeutic connection in neurorehabilitation.

ABOVE:
Left, Associate Professor Louise Parr-Brownlie (Ngāti Maniapoto, Te Arawa) at *right*, BRNZ Māori PhD scholarship recipient, Justine Camp (Kai Tahu).

Te Kura Kaupapa Māori o Hoani Waititi Marae

AT the heart of BRNZ's Māori engagement strategy lie two Māori communities - Te Kura Kaupapa Māori o Hoani Waititi Marae in Tamaki Makaurau (Auckland) and Puketeraki Marae in Ōtepoti (Dunedin). Based at opposite ends of the country, they are two very different places: One a bustling urban marae that serves the greater Māori community in West Auckland, the other a small rural community on the outskirts of Karitane. Despite their differences, BRNZ's engagement with each community - by way of annual wānanga on each marae - has played a critical role in improving our understanding of tikanga and te reo Māori, and of what Māori need and value most from our research. For Hoani Waititi and Puketeraki marae, getting to know BRNZ has enabled them to learn more about neuroscience and science-related careers, to participate in research, and to develop research ideas based on their own priorities and culture.

It's through reciprocal relationships like these, that BRNZ aims to deliver more meaningful, culturally appropriate research, leading to improved health outcomes for Māori.

In 2019, and as an example of our working partnership with the marae, a team of AUT researchers held a hui with Hoani Waititi students to collaborate on a study into therapeutic connection in neurorehabilitation. Prof Nicola Kayes and her team are looking at how healthcare workers interact with people coping with the consequences of a neurological injury or illness. As part of the study, they aim to develop a measure for clinicians to reflect on and inform their practice. To build a tool that is relevant to Māori, they have captured Māori perspectives in a number of wānanga – including the hui at Hoani Waititi marae. Together, Nicola's team and the students explored the varied ways of thinking about key concepts of te ao Māori, such as wairua (spirit), whanaungatanga (relationships), and hononga (connection). As a next step, the team are bringing these insights into their data analysis to help refine the measure.

For Nicola, it is important to show the students just how valuable their insights are, and how their knowledge of te ao Māori and te reo can be applied in a health research context. To do this, she plans to give them a taste of university at AUT in 2020, and encourage them to think about pursuing a career in health or science.

Working towards cultural competency

IN Aotearoa NZ, Māori have the worst health inequality of any group. Māori die younger, and suffer poorer health than non-Māori, particularly as a result of chronic conditions such as vascular disease, cancer, mental illness and diabetes. Māori also have less access to clinically and culturally competent health services, and, according to data from ACC, receive less effective treatment than non-Māori when they do see health professionals.

To close the gap in health status and outcomes for Māori, BRNZ has adopted the Takarangi Cultural Competency programme - the most highly regarded programme in NZ health services– to help our workforce develop the skills and knowledge it needs to provide genuinely competent services to Māori. Having introduced the programme in 2018, 64 BRNZ members, including 30 early career researchers, have now participated in Takarangi training, significantly improving their understanding of tikanga, mātuaranga and te ao Māori along the way.

In 2019, BRNZ held three courses, each an overnight marae stay (noho marae) based at Puketeraki Marae (Dunedin), Te Hui Amorangi o te Waipounamu (Christchurch) and Piritahi Marae (Waiheke Island) respectively. Our researchers also had the opportunity to attend one further session, also at Piritahi Marae (Waiheke Island), in collaboration with The Royal Australian and New Zealand College of Psychiatrists (RANZCP). During the training, participants were introduced to the 14 competencies of the Takarangi Framework, taught to self-assess their current level of each competency, and what they could do to improve. They also discussed how the competencies could be applied in a professional setting and ways to further incorporate Māori values and practices to become more culturally responsive. Being a process rather than an ultimate goal, individuals who attend Takarangi training develop their cultural competence in stages, building on the knowledge and experience gained in prior sessions.

BRNZ aims to support all of our researchers in their journey to cultural competency, with the ultimate goal of producing well-rounded researchers equipped to work effectively with Māori, and a supportive environment for our Māori researchers.

BRNZ takes its place at Te Matatini

THE Te Matatini Festival is considered the pinnacle of Māori performing arts and one of the most significant cultural events in New Zealand. Held every two years, it has become a hotly anticipated event for Kapa Haka performers, their fans and whānau, and since 2017, for Brain Research New Zealand.

While we admit few would look at BRNZ and think "kapa haka championships", our drive to engage increasing numbers of Māori in neuroscience has made it a strong focus of engagement for the CoRE. In February 2019, BRNZ attended the festival once again, this time sharing our stall with the Ageing Well National Science Challenge (NSC). BRNZ member Assoc Prof Louise Parr-Brownlie was appointed as Co-Director (Māori) of Ageing Well this year, creating more opportunities for BRNZ and the NSC to collaborate, both in research and in engagement activities.

Boasting more than 60,000 visitors over four days, the sense of community at Te Matatini was undeniable, and we were pleased at the number of festival-goers who stopped by to meet the BRNZ crew. Along with Being Brainy activities for tamariki, a big drawcard this year were the blood pressure checks BRNZ's Kaiwhakahaere Māori, Dr Hinemoa Elder had to offer which were taken up by over 150 visitors: "*Taking people's blood pressure was my way of connecting in a useful way with audiences,*" says Hinemoa "*and providing something they might not have gotten around to doing.*" And connect we did. Beyond visitors to our stall at the festival, BRNZ received significant social and mainstream media coverage during the event, including an interview with Hinemoa by Māori TV, broadcast live to tens of thousands of New Zealanders.

ABOVE:
Main, performers take the stage at the 2019 Te Matatini festival in Te Whanga-nui-a-Tara (*Wellington*).
Top right, BRNZ's Kaiwhakahaere Māori, Dr Hinemoa Elder.

Empowering Māori to fight dementia

EVEN though Māori are diagnosed with dementia much younger than non-Māori, and it is predicted that they will make up 8% of New Zealanders living with dementia by 2038, little is known about how this disease affects Māori. Most research is still conducted through a western lens, and services – from education to assessments to treatments – are predominantly aimed at New Zealand Europeans. But fortunately, there are people amongst us who are trying to change the story.

Dr Makarena Dudley (Te Rarawa, Te Aupōuri, Ngāti Kahu) has made it her mission to improve Māori health and wellbeing during ageing, and while doing so, empower Māori to determine their own pathways to health. Recently, Makarena has been developing an app for the prevention of dementia or, as it is called in te reo Māori, mate wareware. *"Our ultimate goal is to reduce dementia in Māori,"* Makarena explains. *"I think we can assist in achieving that goal by providing an app that raises awareness and informs. After all, education is empowerment!"*

With funding from BRNZ and the Medical Technologies (MedTech) CoRE, Makarena has assembled a diverse, inter-institutional team, drawing on the expertise of Marcus King from MedTech and Callaghan Innovation, Hohepa Spooner (Ngāti Kahungunu, Ngāti Hineuru) from AUT, researchers from the University of Auckland and AUT, and health care workers focusing on dementia.

Collaboration has also been central to the development process, with the end-users as critical partners at every step. Kaumātua of whānau affected by mate wareware helped to identify the topics that should be covered in the app, and they also suggested to consult mokopuna (grandchildren), as they are critical in supporting their whānau when it comes to accessing technology.

Taking the time to find out what Māori need and want from such an app, will ensure it has real impact, Makarena says. It is clearly made for Māori, which is reflected not only in the creation process, but also in the app interface. In accordance with tikanga Māori, users are welcomed to the app through an introduction and karakia by kuia and kaumātua. All the people featured in videos are Māori, from the social worker to the whānau affected by mate wareware. Fact sheets and research findings went through the process of "whakamāori", where the wording is adapted to make it more suitable to Māori users.

Makarena and her team have built a prototype of the app called "Te Ōranga o te Roro", which covers the topics of education and risk reduction, support for kaumātua with mate wareware and their whānau. They are starting user-testing with whānau to further refine the app and aim to fully launch it in 2021. Makarena is very excited about the potential of the app – for decreasing the prevalence of dementia, but also for empowering Māori to take matters in their own hands: *"I sincerely believe that our future and well-being lies with us, within our own culture and having a positive identity."* And we believe that is a vision that can truly change outcomes for Māori and rewrite the story.

"Our ultimate goal is to reduce dementia in Māori. I think we can assist in achieving that goal by providing an app that raises awareness and informs. After all, education is empowerment!"

DR MAKARENA DUDLEY
(Te Rarawa, Te Aupōuri, Ngāti Kahu)

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Quality means ...

BUILDING STRONG COLLABORATIONS BOTH LOCALLY AND ABROAD

sharing our expertise and innovation in the study of the ageing brain with like-minded institutions.

Since its launch in 2015, BRNZ has grown from a fledging collaboration between 70 otherwise independent research groups to an internationally recognised centre supported by extensive research networks and infrastructure. From local collaborations with the Medical Technologies CoRE, the Ageing Well National Science Challenge and the Health Research Council, to being invited to participate in meetings of major international Brain Initiatives, we are now widely known as New Zealand's leading neuroscience research centre. 2019 saw us branch out even further, working with the World Health Organisation, APEC, and China to accelerate efforts to improve the treatment and prevention of ageing-related neurological disease.

ABOVE:
From the UK and Canada to China, South Korea and Slovakia, BRNZ members have research collaborations with researchers in 14 countries across the globe

BRNZ's annual research wānanga

EACH year in late August, BRNZ holds an annual research wānanga to coincide with Queenstown Research Week. It is always a great event that also enables our Māori researchers to gather and discuss issues of importance to them as a rōpū. It's also provides a chance to meet for the national DPRC team, which reviews its clinic protocols and issues that are important to maintaining the high standards of data collection from the participants.

This year we were thrilled to host a number of colleagues from China for a 2-day symposium to identify possible research collaborations between BRNZ investigators and Chinese clinicians and scientists. This symposium, in collaboration with the New Zealand-China Non-Communicable Diseases Research Centre, built on the reciprocal meetings we have had with China colleagues over the last few years. These highlight the international reach of BRNZ and the interest among international experts and research groups in seeking collaborative research partnerships with our Centre. This time we focussed the symposium on three specific areas, as a catalyst to identify priority joint research opportunities in the areas of Stroke, Alzheimer's disease and Parkinson's disease. Eight BRNZ investigators presented their research interspersed with presentations from leading Chinese investigators from Shanghai and Beijing. On the second day, the participants broke into groups and discussed specific research ideas to develop as collaborative grant applications, for example, one study co-led by Prof Anderson (BRNZ) and Prof Jian Wang (Fudan University) is looking the evaluation and diagnosis in Parkinson's disease using motion capture technology. Another led by Prof Snell (BRNZ) and A/Prof You (Fudan University) is looking at the molecular basis of Huntington's disease.

IBI extends invitation

BEYOND China, our international engagement and international recognition of BRNZ as a major New Zealand centre for neuroscience continues to grow. BRNZ is increasingly being invited to participate in meetings of major International Brain Initiatives. Following on from the meeting of International Brain Initiatives the year before in Miyasaki, Japan and sponsored by the Institute of Electrical and Electronic Engineers, we were invited to present at an IBI meeting in Daegu in South Korea in 2019 and at a similar forum at the Australasian Neuroscience Society meeting in Adelaide. The inclusion in these international meetings is further recognition of BRNZ at an international level as a national centre of research excellence on the brain.

ABOVE RIGHT:
National representatives and stakeholders at the 2019 International Brain Initiatives meeting in Daegu, South Korea

14th International Conference on Neurons and Brain Disease

ON 20-22 November, the 14th International Conference on Neurons and Brain Disease was held in Queenstown, supported by sponsorship from BRNZ. With 70 delegates from China, Japan, Korea, Canada, USA as well as New Zealand, this was an intense but highly enjoyable meeting where state-of-the-art neuroscience was on display in an informal atmosphere. Topics were wide-ranging in scope, but included of course many addressing ageing and related neurological disorders. It was very pleasing to see so many BRNZ members in attendance, and with their research clearly right up there with the best in the world. It was also a great opportunity for students and postdocs to meet many high performing neuroscientists and clinicians.

The World Health Organisation

IN October 2019, BRNZ sponsored two important meetings in Auckland on Ear and Hearing Care in the Pacific Region in partnership with the Eisdell Moore Centre. The first, a four-day course on Public Health Planning for Ear and Hearing Care, outlined public health approaches to prevention and treatment of ear disease and hearing loss in resource-limited Pacific Island Countries. Following this, there was a meeting of groups from around the Pacific in association with the World Health Organisation to discuss the nature and development of otology and audiology services for the Pacific Region. Both the meetings are an extension of substantial work being conducted in the Pacific region, including research and support for policy development led by Prof Peter Thorne, to establish a regional service in the Pacific to prevent and treat ear disease and hearing loss.

Asia-Pacific Economic Cooperation (APEC) Health Working Group

IN 2019, Session 6 of the 9th APEC High-Level meeting on Health and the Economy focused its discussions on dementia in APEC member economies. With the number of people living with dementia in the Asia-Pacific Region expected to triple between now and 2050, APEC are actively looking to foster collaboration between member states to accelerate progress on dementia in the Asia-Pacific region.

During Session 6, APEC member economies were invited to spotlight one initiative their economy implemented to address dementia, highlighting innovative approaches being undertaken to promote healthy ageing. For New Zealand's "Dementia Spotlight", the Ministry of Health gave Brain Research New Zealand as an example of an initiative New Zealand has implemented, to illustrate how our economy is aiming to prevent dementia and enable those living with dementia to live well with the condition. After the meeting, BRNZ material was submitted to the World Health Organisation Global Dementia Observatory (GDO) knowledge exchange platform - a space for stakeholders to share resources to facilitate mutual learning and promote the exchange of good practices in the area of dementia.

"Brain research is optimally an internationally cooperative endeavour; BRNZ's outstanding growing connections within the Pacific region and across the globe continue to help us raise our game."

PROFESSOR CLIFF ABRAHAM

TOP:
Representatives from the Pacific Region meet to discuss audiology services in association with the WHO.

ABOVE LEFT:
BRNZ researchers joined with leading international neuroscientists at the 14th Conference of Neurons and Brain Diseases in Queenstown. Support was gratefully received from the Neurological Foundation of NZ and the Maurice and Phyllis Paykel Trust.

Improving hearing health across the Pacific

THE World Health Organisation (WHO) estimates that 466 million people have disabling hearing loss. With that figure predicted to double by 2050, there's a growing need to provide accessible ear health services for all. BRNZ Co-Director Professor Peter Thorne has been working towards this goal in the Pacific for a decade.

It started when Peter took up an appointment as Head of the School of Population Health at the University of Auckland. As part of this role, he visited the Fiji School of Medicine, and it was there he realised that, when it came to hearing loss and ear disease, the country was poorly serviced. He says, *"After meeting with lots of health authorities there, it became clear that, beyond clinicians who regularly travelled from New Zealand to Fiji to do surgeries and fit hearing aids, there was very little in the way of established services. That didn't seem right. With all the resources in NZ, I knew we could do better."*

One of the first priorities for Peter and his colleague, Associate Professor Judith McCool, was to understand the scale of the challenge. Working with several Pacific organisations, they and students Natasha Houghton and Michael Sanders carried out a 'gap analysis', into the prevalence of hearing loss and the provision of services across six Pacific countries (Cook Islands, Fiji, Niue, Samoa, Tokelau, and Tonga). They found that up to 11% of the population may live with a significant hearing impairment, and discussed the challenges of constrained resources, diverse geography, and a shortage of local expertise. In that same study, the team highlighted the need for an international collaborative effort, led by Pacific peoples, to establish and maintain hearing services for those living on the islands. *"That was an important piece of research,"* says Peter, recalling the experience. *"But the reality is that those doing the work are incredibly stretched. It's hard to establish something of that scale. The biggest thing we can do is continue; to help relieve the pressure, find resources, coordinate activities, make connections, whatever is needed."*

Around the same time, Peter starting working with the WHO, through Dr Shelly Chadha, who oversees the organisation's programme on deafness and hearing loss. *"Our Pacific partners have turned that relationship into some fairly significant initiatives which are now building lots of capacity and capability within the Pacific,"* Peter says. One of the organisations leading this effort is the Secretariat of the Pacific Community (SPC). In 2015, they had developed a program to strengthen clinical partnerships and services in the Pacific region. Peter and PhD student Liz Holt were invited to join one of the associated groups – the Pacific ENT and Audiology Group (PENTAG). *"This has grown into a huge program, thanks to the leadership of people like Berlin Kafoa and Oh Chunghyeon in Fiji, and Sepiuta Lopati and Sione Pifeleti from Tonga and Samoa, respectively."* WHO is currently trialling some new training manuals in the region, because, according to Peter *"they see the Pacific as the perfect place to develop high-quality, community programmes in ear health. There's an engine room there now, and it's being driven by Pacific people themselves. It's exciting."*

Peter is also heavily involved in work programs closer to home. With Dr Ravi Reddy, a public health specialist now at Massey University, he's been looking at the attitudes of older, NZ-based Pacific Islanders to their hearing impairments. And the Whānau Pathfinder program, developed through a BRNZ-funded research collaboration with Ravi and Hearing Auckland's Cynthia Brown-Mendes (Ngāti Whātua and Orakei and Kaipara Marae), he is looking at hearing loss from a Māori perspective. Guided by the Kaupapa Māori research framework, which emphasises that research should be by, with, and for Māori, this project has taken more than a hundred people from screenings through to having hearing aids fitted. *"This has been led by Cynthia who has been absolutely instrumental in its success,"* says Peter. *"She's been the one building connections with Māori in West Auckland and the Kaipara."*

"Hearing loss has enormous implications for older people," Peter says. *"It can reduce socialization, isolate people from their whānau, and it contributes to cognitive decline. We hope that by developing a better understanding of Māori perceptions of hearing loss, we can create a clearer, more equitable route for them to access hearing health services."*

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Quality means ...

PARTNERING WITH THE COMMUNITY AND SHARING WHAT WE KNOW

to improve public awareness and to provide opportunities for mutual learning, expanding the reach of our work.

Community engagement, whether it is face-to-face, via a visit to the theatre, or over social media, encourages people to think about brain research and understand the importance and relevance of our work. In 2019, BRNZ enjoyed another busy year in the community, supporting a ground-breaking play about Alzheimer's disease, initiatives to encourage students into neuroscience, Brain Awareness Week, and activities focused specifically on strengthening our relationships with Māori. In the following pages we highlight some of the many ways BRNZ engaged with the public this year, building a stronger community to effect change.

TOP:
Community group representatives participate in a panel discussion at BRNZ's national conference: (from left), Prof Ngaire Kerse (BRNZ, moderator), Don Scandrett (Stroke Foundation), Paul Sullivan (Dementia NZ), Stephanie Clare (Age Concern), Deirdre O'Sullivan (Parkinson's NZ) and Catherine Hall (Alzheimers NZ).

BRNZ's inaugural national conference

IN March 2019, BRNZ invited its investigators, Early Career Researchers (ECRs), Scientific Advisory Board members, community partners, and kaumātua from across the country to the CoRE's first full national conference. Held in Auckland, the hui attracted 152 people including representatives from Alzheimer's New Zealand, Stroke Foundation, Parkinson's New Zealand, Dementia Auckland, Huntington's Association NZ – our key stakeholders. It was a wonderful hui, particularly the panel discussions that included key community and Māori representatives who provided input to our research agenda. We were also delighted to host our first Faull Lecture, delivered by Prof Mike Dragunow, from the University of Auckland, a long-time friend and colleague of Sir Richard Faull. Dr Waiora Port a kuia and member of the Māori Advisory Board delivered a wonderful introduction to the lecture, highlighting Sir Richard's commitment to supporting Māori and working with Māori communities to conduct impactful research. Mike spoke – at times a little irreverently - of Sir Richard's passion for neuroscience and the community, and his of compassion and wisdom. The meeting highlighted to everyone the strong sense of collegiality, passion and commitment that exists among BRNZ's extended "family" and the outstanding research underway in the CoRE. This was endorsed by the members of our International Science Advisory Board, which met the day before.

Brain Awareness Month

BRAIN Awareness Month is one of the busiest times in our outreach calendar, with thousands of people coming to our events to learn about brain science. Linked to a global campaign to increase public awareness of the benefits of brain research, the Neurological Foundation of New Zealand (NFNZ) leads the campaign in New Zealand. Since BRNZ's inception in 2015, BRNZ has been a key player in Brain Awareness Month, taking the opportunity to share our research and expertise with the New Zealand public.

2019 was no exception. In Auckland, we continued our partnership with the Centre for Brain Research and the NFNZ holding a number of research seminars featuring BRNZ members. The main event, Brain Day, took place at the end of the week on March 23rd and featured public talks by a number of BRNZ members including, Being Brainy activities, a performance by the CeleBRation Choir, and interactive science displays.

In Dunedin, BRNZ joined forces with Otago's Brain Health Research Centre and the NFNZ, to deliver a week of research seminars across a fascinating range of topics. This year, we had the privilege of introducing BRNZ Science Board member Prof John Rostas to the public. Prof Rostas joined Prof Cliff Abraham for an entertaining fireside chat about neuroplasticity - the brain's amazing ability to adapt and change by reorganising itself. Brain Day Dunedin was held on Saturday 16 March, and included a day of short lectures, children's activities, community group displays plus an educational, if perhaps slightly daunting, walk through an enormous inflatable brain. The week closed on a high with "Senior Brain Day" featuring a performance by the Otago Neuro Choir and a talk by BRNZ clinician, Dr Gary Cheung.

ABOVE RIGHT:
BRNZ Early career researchers share their passion for neuroscience at Brain Day in Auckland.

When Being Brainy comes easily

LAUNCHED in 2017, Being Brainy has quickly become BRNZ's flagship outreach programme. Developed and led by Prof Bronwen Connor, it is an eight-week inquiry programme for primary and intermediate schools to teach children about the brain.

Bronwen, a full-time working mum with two young sons, was first motivated to set up Being Brainy after experiencing the low level of science education her own children received during primary and intermediate school. Her passion for neuroscience and science education led her to create a programme that would provide teachers with all the resources they would need to make neuroscience easy to teach, so young children would see it as interesting, important and fun.

Three years down the line, and Bronwen's vision is taking shape with over 350 schools across New Zealand signed up to use the programme, which now includes a new lesson on memory and learning and yearly drawing competitions. To extend the reach of Being Brainy even further this year, BRNZ took the programme to Alexandra in October, running our first "Brain Lab" - a one-day school holiday programme - at the local iSite Visitor Information Centre. More than 200 people showed up on the day – children, parents, grandparents, and teachers – all excited to see and touch real brains, try hands-on experiments, and to learn fun facts about the human brain.

With demand for Being Brainy increasing year-on-year, both in and out of term time, it seems Bronwen's passion for neuroscience is catching on. When asked what her proudest moment has been in bringing it to schools, she recalls a young boy who came up to her after a school visit and asked for her autograph. Thinking he was teasing, she signed his piece of paper, only to look up and see a long line of students waiting for their turn: *"The students called me "the Brain Lady" and several told me they wanted to be just like me when they grew up. To me, that moment demonstrates we are showing school kids that science and scientists are important and cool!"*

BRNZ hopes to support more schools and teachers in adopting Being Brainy next year, to play our part in improving the science literacy of New Zealand school children, with the ultimate goal of increasing the number of Kiwi kids pursuing a science education.

Competition heats up

WHILE Being Brainy caters to children between the age of 6 and 11, the New Zealand Brain Bee Challenge is a competition for Year 11 high school students to learn about the brain, brain research and careers in science and technology.

An annual event, it follows the same format each year: an online quiz in March, is followed by a second round where top scoring students go on to compete in either the North Island or South Island Finals. The two winners then go forward to compete for the title of New Zealand Brain Bee Champion, and represent the country in the international competition.

New Zealand's first Brain Bee was held in 2006, but interest in the competition has grown significantly in recent years, due in no small part to A/Prof Debbie Young, who has run the North Island competition for the last two years. For Debbie, it's the excitement of the competition and the students' enthusiasm that make it all worthwhile. It is also the standout competitors who get everybody on their feet and cheering: *"like the young Māori student from a small town in the middle of the North Island who entered because he has a dream of being neurosurgeon"* she recalls, speaking of a student who caught her attention this year.

In 2019, 58 schools across New Zealand signed up to compete in Brain Bee, with 230 students progressing to the regional finals held at the Universities of Auckland and Otago. We were especially excited to see another contingent of Māori students from the Far North come through the MOKO Foundation, a partnership we initiated in 2017. In a new North Island initiative this year, Debbie and her team trialled a "Golden Ticket" competition, where 10 students entered into a random draw to get the chance to spend the day at the University of Auckland with our researchers, to truly experience a day in the life of a scientist and learn about the opportunities available to them in neuroscience.

"The students called me "the Brain Lady" and several told me they wanted to be just like me when they grew up. To me, that moment demonstrates we are showing school kids that science and scientists are important and cool!"

PROFESSOR BRONWEN CONNOR

Getting the show on the road

SITTING to the right of the stage, in an old woolly jumper, Bob readjusts himself in his chair and leans forward slowly to speak: *"You know we are our memories in many ways aren't we? And when that goes, our understanding of ourselves disappears doesn't it, really?*

As he speaks, he replays an interview about Alzheimer's disease (AD), that Dunedin-based playwright Cindy Diver conducted with a local neuropsychologist and expert in AD. But Bob is not alone, he is one of 17 people Cindy and GP Suzie Lawless interviewed for their verbatim play, *The Keys are in the Margarine*, about the realities of living with dementia.

As a verbatim play, *The Keys* aims to reproduce real-life conversations Cindy and Suzie had with people with dementia, their partners and family members, professional caregivers, and medical experts. The characters' anonymity gives them the freedom to 'tell it like it is', leaving the physical, emotional and social cost of Alzheimer's clear for all to see. Take for example, Myra (60), who audiences get to know during the course of the play as she reflects on her husband's experience with the disease: *"It's a cruel condition, that takes away a person's life, and um, gradually, bit by bit. So make the most of your life while you can. Do what you can while you can. That's the motto... get in there and do it while you can."*...

Dementia isn't always easy to talk about so when BRNZ learnt that the team behind *The Keys* was hoping to take the play on tour in October, we saw an opportunity to lend our support to spread the key messages of the play - many of which overlap significantly with ours - more widely throughout New Zealand. The result? Ten tour dates, nearly 1300 ticket sales, over a dozen media appearances and universal rave reviews from the critics. We were particularly proud to sponsor a special performance of the show in Wellington on 12 October, where BRNZ Co-Director, Prof Cliff Abraham, led an expert panel discussion and Q&A session for audience members with Dr Phil Wood (Ministry of Health's Chief Advisor on Healthy Ageing), Prof Lynette Tippett (Director of NZ's Dementia Prevention Research Clinics) and Cindy Diver.

As clinicians and neuroscientists, BRNZ aims to improve quality of life and positive ageing for older persons and their whānau not just through our research, but through public awareness and partnership with the community. Increasing awareness of dementia is known to lower the stigma associated with it, to lead to earlier diagnosis, and to help people diagnosed with the condition come to terms with it and seek the support they need. Improving dementia knowledge for a wide range of health and social support professionals will also lead to better outcomes for people diagnosed with the condition.

But while we have the expertise and knowledge to educate people about Alzheimer's disease, it can take an experience like *The Keys* to engage the public at an emotional level, and to truly bring home what means to be diagnosed with Alzheimer's disease, or to live with and care for someone with the condition.

If, as Augusto Boal said "theatre is a weapon", then we are happy to add it to our arsenal as we work to improve people's attitudes and behaviours towards their brain health, and ultimately, stave off Alzheimer's disease for longer.

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"Dementia doesn't just affect memory, it affects everything that person does do, that they end up not being able to dress themselves, feed themselves, can't just do those, basic things".

(Rachel) 54

ABOVE:
BRNZ CO-Director, Prof Cliff Abraham, moderates an expert panel discussion with Dr Phil Wood, Associate Professor Lynette Tippett and Cindy Diver, after a performance of *The Keys are in the Margarine* in Wellington.

In the following pages we invite you to take a tour of BRNZ's community and see how our research findings are disseminated and used by a diverse group of stakeholders to contribute to a range of impacts. From the New Zealand Government to local marae, we show how BRNZ's research and related activities have informed policy and the design and delivery of health services, how we support innovation in industry, and technical and personal skill development. We also show how our knowledge exchange with community groups, health professionals and the public, influences people's attitudes and behaviours, and enhances their quality of health and life.

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Quality means ...

PUTTING THE KNOWLEDGE AND SKILLS WE GENERATE TO GOOD USE

for the economy, for society, and for everyday New Zealanders living out their old age.

Mapping impact

A — The tertiary education sector

At the heart of BRNZ lies a collaborative, multi-disciplinary research environment that is home to 73 top neuroscientists and clinicians from four partner institutions. From this hub, BRNZ has trained a *new generation of highly qualified neuroscientists and clinicians*, including a growing Māori health and neuroscience workforce. We have also generated valuable *new knowledge and shared ideas*, publishing 1089 peer-reviewed articles in prestigious journals along with 3 books and 48 book chapters since 2015.

The *national neuroscience research network* we have built facilitates collaborative, translational research, enriched by partnerships with the MedTech CoRE and the Ageing Well National Science Challenge. Our research platforms, including the Dementia Prevention Research Clinics, have enhanced the *national research infrastructure*, and supported more than 40 nationally and internationally collaborative studies, several with industry partners.

B — Government and government agencies

At a Government level Dr Phil Wood, Chief Advisor - Healthy Ageing, Ministry of Health, and Prof Richie Poulton, Chief Science Advisor to the Minister for Child Poverty Reduction, are key conduits for *impact on public health policy, leading to improved population health*. BRNZ's research into stroke and dementia in particular, is well recognised by the MOH. For example, Dr Makarena Dudley's article "*Dementia from a Māori perspective*" is anticipated to have significant impact on current clinical activity (especially in the context of our responsibilities under the Treaty of Waitangi). Similarly, Dr Gary Cheung's research into CST, an evidence-based psychosocial treatment for dementia, has been used by the MOH to assess its acceptability in the New Zealand context.

BRNZ researchers are also frequently invited to the Ministry of Health and other government agencies to speak to topical issues and support policy development and funding decisions, evidence of the clinical relevance of both published and work-in-progress within the CoRE.

C — Industry

BRNZ's research contributes to technological innovations that result in new and improved products and services, as evidenced by 11 patent applications and two patents granted. Our researchers have a strong track record of successful technology transfer and commercialisation of research findings in spin-out companies, e.g. Tinnitus tunes, the Stroke Riskometer App as a preventative tool and the PREP2 stroke algorithm to predict upper limb recovery after stroke.

D — District Health Boards, GP practices, healthcare providers

With 16% of BRNZ's members working as clinicians (neurologists, GPs, neurosurgeons, old age physicians, GPs and psychiatrists) in District Health Boards that service most of the country, much of the knowledge BRNZ generates is directly applied into policies and practices that improve standards of clinical care and of the health system writ large. BRNZ clinicians implement evidence-based treatment strategies and culturally appropriate interventions by virtue of their roles in writing the guidelines for investigation and treatment of stroke, dementia, PD and HD for their local District Health Boards via Health Pathways – the key resource for hospital and community doctors in each DHB region.

BRNZ also plays a key role in educating primary care practitioners. Prof Ngaire Kerse, Prof Phil Wood and Dr Gary Cheung have developed podcasts and online learning tools for the Goodfellow Unit (University of Auckland) for clinical education and training.

We have also facilitated skills-based training workshops for allied health professionals. Over 280 healthcare professionals, with established links to allied health networks and community activity groups (including retirement villages and aged care facilities) have received training in the Ronnie Gardiner Method (RGM) and Cognitive Stimulation Therapy (CST). The goals are thereby to improve community-based neuro-rehabilitation services.

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E — Māori communities

Through partnership with Māori communities and researchers, we have reciprocally shared knowledge and expertise, funded a programme of research that specifically focuses on Māori brain health needs, and supported the development of new products and services for the specific benefit of Māori, e.g. a dementia app for Māori and the MANA diagnostic tool. By building a thriving Māori health and neuroscience workforce, and improving the cultural competency of our researchers we are reducing barriers to accessing services, and improving standards of research and healthcare for the benefit of Māori communities across New Zealand.

F — Primary and Secondary Schools

Through science outreach programmes like Being Brainy and the Brain Bee competition, along with public engagement activities like Brain Awareness Week, BRNZ's work fosters interest in neuroscience in children, increases science literacy and student achievement, and raises awareness of science-related education pathways and career opportunities.

G — Community groups

Through partnership and knowledge exchange with key community groups, e.g., Alzheimer's New Zealand, the Stroke Foundation, Age Concern, Dementia New Zealand, Parkinson's Society and the Huntington's Disease Association, BRNZ is able to shape patient education and influence people's attitudes and behaviours. For example, Prof Anderson and Dr Matthew Croucher are medical advisors to Parkinson's New Zealand which disseminates evidence-based findings to its networks. A/Prof Barry Snow is Chair (and Prof Anderson a member) of the Council of the Neurological Foundation of New Zealand, a major national organisation that provides education for patients and the wider public via regular newsletters and public education seminars, with considerable involvement from BRNZ members.

H — International collaborations

BRNZ's research is increasingly used across institutions, disciplines and borders. By funding high-quality research with international impact, and collaborating extensively with researchers in Australia and China, BRNZ is playing its part in the global effort to reduce the impact of ageing on brain health, including with indigenous communities.

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Awards and accolades

1. **Distinguished Prof Dame Margaret Brimble** was named a Dame Companion of the New Zealand Order of Merit in the 2019 New Year Honours for her world-class contributions to research in medicinal chemistry. Margaret also won the BNZ Supreme Award and the Baldwins Researcher Entrepreneur Award at the 2019 Kiwinet Research Commercialisation Awards, recognising her pioneering work in drug discovery and development.

2. **Dr Hinemoa Elder** was appointed a Member of the New Zealand Order of Merit for her services to psychiatry and Māori. The appointment recognises Hinemoa's efforts in advocating for greater awareness of Māori cultural needs in the health sector.

3. **Prof Valery Feigin** was elected as a Fellow of the Royal Society Te Apārangi. The Royal Society noted the profound international impact of his research on stroke and traumatic brain injury and his novel approach to stroke prevention through motivational population-wide intervention. Valery was also elected a Foreign Member of the Russian Academy of Sciences, which is regarded as the highest scientific institution in Russia.

4. **Assoc Prof Anne-Marie Jackson** received the Royal Society Te Apārangi Te Kōpūnui Māori Research Award. This award is given to recognise innovative Māori research with a promising trajectory and recognizes her outstanding efforts in forging new knowledge at the interface of mātauranga Māori and the physical sciences. Anne-Marie also received a Kaupapa Māori Teaching Award from the University of Otago for her dedication to providing alternative ways to engage with Māori communities.

5. **Prof Richie Poulton** was awarded the University of Otago's 2019 Distinguished Research Medal. The University of Otago's most prestigious research prize rewards outstanding scholarly achievement that leads to significant advances in activities of the university. Prof Richie Poulton was also named in the top 1% most-cited researchers in science in the world. Prof Poulton, director of the university's Dunedin Multidisciplinary Health and Development Study, is the only New Zealand researcher named in the top 1% section of the 2019 Clarivative Analytics Highly Cited Researchers Award List in the field of Psychiatry and Psychology.

6. **Prof Dirk De Ridder** was awarded the University of Otago's Dean's Medal at the Health Research Excellence Awards for his work on neuromodulation to treat brain conditions ranging from addiction to Parkinson's Disease.

In the media

Working with the media is one of BRNZ's key strategies to disseminate our research findings and engage with the public. In 2019, BRNZ researchers and their work featured prominently in national media - on average six times a week – across a range of popular sources including Radio New Zealand, the NZ Herald, TV3, TVNZ news, North and South magazine, and the Listener to name but a few.

The following are examples of stories that made the headlines:

In January, **Prof John Reynolds** and **Prof Dirk De Ridder** featured heavily in the news for their innovative stroke recovery solution, where the healthy side of the brain is targeted instead of the damaged one.

The **Dementia Prevention Research Clinics** (DPRC) caught the media's attention many times in 2019, most notably in pieces celebrating the launch of third clinic, which we launched in Christchurch this year. The DPRC was also the focus of a feature article on Noted (*North & South*) by Donna Chisholm, following up with one of the first DPRC study participant.

Prof Ngaire Kerse and her work on healthy ageing, New Zealand's ageing population and the risk of falls proved popular with the media, appearing regularly in the New Zealand media throughout the year, including pieces in the *NZ Herald*, RNZ, *NZ Doctor*, Newstalk ZB, Newsroom, and in international media.

In 2019, Brain Research New Zealand partnered with a theatre company to bring **"The Keys Are in the Margarine"**, a play about dementia, to stages across New Zealand. This project was featured heavily in the news. Notably, Prof Cliff Abraham was interviewed on RNZ – Nine to Noon, articles were published on The Spinoff, in the *NZ Listener* and numerous local newspapers.

Prof Bronwen Connor appeared on the AM Show (Newshub) to comment on the development of lab-grown human brains, discuss whether science should have a limit, and to talk about her cell reprogramming research.

In October, **Dr Makarena Dudley's** research on dementia from a Māori worldview and the importance of cultural identity when treating dementia was the focus of several news items and a Radio New Zealand interview.

Prof Cliff Abraham and **Dr Anurag Singh's** discovery of the role a particular protein plays to impair memory in Alzheimer's disease, which in the future could lead to more effective treatments, was discussed widely in the media.

Distinguished Prof Sir Richard Faull featured in the media numerous times, with a string of TV and radio interviews on the extension of the Neurological Foundation Human Brain Bank. He also featured in two *NZ Listener* articles by Clare de Lore on the Brain Bank and his work on Huntington's disease.

Several of our Early Career researchers featured in the media in 2019. **Dr Malvindar Singh-Bains** regularly appears as a science commentator on RNZ – Nine To Noon, she was featured on TVNZ and in the *NZ Herald*, and published an opinion piece on Newsroom. **Dr Brigid Ryan** was part of TVNZ's myth-busting health series, *"The Check Up"* (alongside **Prof Maurice Curtis**). She also published a piece on dementia on Newsroom and appeared on Newstalk ZB.

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 2019 BRNZ researchers continued to dedicate their time and 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
- Australasian Winter Conference on Brain Research
- Community Care Trust Otago
- 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 and Hard of Hearing
- 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

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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
- American Tinnitus Association Scientific Committee
- 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 Health Organisation – World Report on Hearing
- World Stroke Organization

Editorial Boards

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

- American Journal of Physiology
- Audiology and Neuro-otology
- 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

RESEARCH OUTPUTS

Patents

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. 2019 Awarded PCT. PCT/DK2019/050041

Books

1. Wiebers, D., Feigin, V., & Brown, R.Jr. (2019) *Handbook of Stroke*. Wolters Kluwer Health.

Book Chapters

1. Cheung, G., & Casey, J. (2019). Role of an Old Age Psychiatrist. In R. Butler & C. Katona (Eds.), *Seminars in Old Age Psychiatry* (College Seminars Series, pp. 216-229). Cambridge University Press. DOI: 10.1017/9781108593946.019

2. Hegemann R.U., & Abraham W.C. (2019) Electrophysiological Investigation of Metabotropic Glutamate Receptor-Dependent Metaplasticity in the Hippocampus. In: Burger C., Velardo M. (eds) *Glutamate Receptors. Methods in Molecular Biology* (vol 1941, pp. 79-91). Humana Press. DOI: 10.1007/978-1-4939-9077-1_7

3. Rashid U., Signal N., Niazi I.K., Taylor D. (2019) footPress: An Open-Source MATLAB Toolbox for Analysis of Pedobarography Data. In: Masia L., Micera S., Akay M., Pons J. (eds) *Biosystems & Biorobotics: Converging Clinical and Engineering Research on Neurorehabilitation III* (vol 21, pp. 361-364). Springer. DOI: 10.1007/978-3-030-01845-0_72

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Journal Articles

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55. Nasrollahi, N., Machado, L. (2019) Age Differences in the Processing of Emotional Information: A Meta-Analysis investigating Face versus Non-Face Pictures as Potential Moderators. Poster session presented at Australasian Neuroscience Society, .

56. Ohline, S.M., Chan, C.H., Whelan, J., Smith, H., Logan, B.J., Morrissey, J.A., Schoderboeck, L., Peppercorn, K., Tate, W.P., Hughes, S.M., & Abraham, W.C. (2019) Stimulation of neurogenesis by a potential therapeutic protein. 37th International Australasian Winter Conference on Brain Research, Queenstown, New Zealand.

57. Ohline, S.M., Wake, K.L., Hawkridge, M.-V., Dinnunhan, M.F., Hegemann, R.U., Wilson, A., Schoderboeck, L., Logan, B.J., Jungenitz, T., Schwarzacher, S.W., Hughes, S.M., & Abraham, W.C. (2019) Adult-born dentate granule cell excitability depends on the interaction of neuron age, ontogenetic age and experience. 4th Eurogenesis Meeting, Bordeaux, France.

58. Oorschot, D.E, Parr-Brownlie, L.C., Smither, R.A., Wicky, H., Hughes, S.M., Bilkey, D.K., Seo, S. (2019) Changes in midbrain dopamine circuitry in the maternal immune activation rat model of schizophrenia. International Basal Ganglia Society Conference, Biarritz, France.

59. Oorschot, D.E, Parr-Brownlie, L.C., Smither, R.A., Wicky, H., Hughes, S.M., Bilkey, D.K., Seo, S. (2019) Changes in midbrain dopamine circuitry in the maternal immune activation rat model of schizophrenia. International Congress for Stereology and Image Analysis, Aarhus, Denmark.

60. Papagama, T.H., Waldvogel, H.J., Faull, R.L.M., & Kwakowsky, A. (2019) Neuroinflammation in the Human Cingulate Cortex in Huntington's disease. 39th Annual Scientific Meeting of the Australasian Neuroscience Conference, Adelaide, Australia.

61. Papagama, T.H., Waldvogel, H.J., Faull, R.L.M., & Kwakowsky, A. (2019) Neuroinflammation in the Human Cingulate Cortex in Huntington's disease. The HOPE-Selwyn Knowledge exchange for Research on Aging, Auckland, New Zealand.

62. Peeters, W.M., Gram, M., Sheard, P., & G. Dias, D.S. (2019) Which whey forward? Nuancing the effects of post-exercise whey ingestion in type 2 diabetes mellitus. 24th Annual Congress of the European College of Sport Science (ECSS), Prague, Czech Republic.

63. Peppercorn, K., Kleffman, T., Hughes, S., & Tate, W. (2019) Proteome changes in Glial Cells after exposure to Secreted Amyloid precursor protein - alpha. 39th Annual Scientific Meeting of the Australasian Neuroscience Conference, Adelaide, Australia.

64. Purdy, S.C. (2019) Contributions of evoked response audiometry to our understanding of auditory processing deficits in children & older adults. 20th Anniversary of Korean Evoked Response Audiometry Study Group, Seoul, South Korea.

65. Purdy, S.C. (2019) Hearing loss and cognition: Explaining speech perception difficulties in adults. 67th Korean Audiological Society Symposium, 18 May 2019, Seoul, South Korea.

66. Purdy, S.C., Leung, L., Baily, M., Keith, W.J., Smart, J.L., Kelly, A.S., & Kuruvilla-Mathew, A. (2019) Objective measures of brainstem auditory processing. XXVI International Evoked Response Audiometry Study Group (IERASG) Biennial Symposium on 30 June-4 July 2019, Sydney, Australia.

67. Ranta, A., Barber, P.A., Harwood, M., Cadilhac, D., McNaughton, H., Thompson, S., Fink, J., Davis, A., Gommans, J., Girvan, J., Abernethy, G., Feigin, V., Wilson, A., & Douwes, J. (2019) New Zealand Hospital Stroke Service Provision: A National Survey. ANZAN annual scientific meeting 2019, Sydney, Australia.

68. Ranta, A., Barber, P.A., Harwood, M., Cadilhac, D., McNaughton, H., Thompson, S., Fink, J., Davis, A., Gommans, J., Girvan, J., Abernethy, G., Feigin, V., Wilson, A., & Douwes, J. (2019) New Zealand Hospital Stroke Service Provision: A National Survey. Australasian Stroke Society Meeting, September 10-13, 2019, Canberra, Australia.

69. Ranta, A., Barber, P.A., Harwood, M., Cadilhac, D., McNaughton, H., Thompson, S., Fink, J., Davis, A., Gommans, J., Girvan, J., Abernethy, G., Feigin, V., Wilson, A., & Douwes, J. (2019) New Zealand Hospital Stroke Service Provision: A National Survey. International Stroke Conference, Honolulu, Hawaii, USA.

70. Ranta, A., Barber, P.A., Harwood, M., Cadilhac, D., McNaughton, H., Thompson, S., Fink, J., Davis, A., Gommans, J., Girvan, J., Abernethy, G., Feigin, V., Wilson, A., & Douwes, J. (2019) New Zealand Hospital Stroke Service Provision: A National Survey. SSA 2019 Conference, Canberra, Australia.

71. Roxburgh, R., Beecroft, S., Cortese, A., Dyer, Z., Mossman, S., Wu, T., Pelosi, L., Mulroy, E., Leadbetter, R., Chancellor, A., Anderson, T., Cutfield, N., Taylor, R., Ravenscroft, G., Sullivan, R., Reilly, M., Houlden, H., & Laing, N. (2019) Patients with cerebellar ataxia, vestibular areflexia and neuronopathy syndrome (CANVAS) of Polynesian Ancestry have a novel conformation of their RFC1 repeat. SPATAX meeting (International meeting for Hereditary Spastic paraparesis and ataxia;) September 2019, Nice, France.

72. Roxburgh, R., Rodrigues , M., Hodgkinson, V., Korngut, L. , Schoser, B., Montagnese, F., Wenninger, S., Segovia, S., Diaz-Maera, J., El Sherif, R., Takada, H., Kastreva, K., Tournev, I., Vohanka, S., Mazanec, R., Porter, B., Bettolo, C.M., Stojanovic, V.R (2019) Affiliation to the TREAT-NMD consortium using an agreed minimum dataset allows small registries and large registries to collaborate together. International Myotonic Dystrophy (IDMC-12) Consortium June 2019, Gothenburg, Sweden.

73. Sateesh, S., Jones, O.D., Singh, A, & Abraham, W.C. (2019) Synapse-specific long-range heterosynaptic metaplasticity in the rat hippocampus. FENS Regional meeting, Belgrade, Serbia, Poster 173. Poster session presenation at the FENS Regional meeting., Belgrade, Serbia.

74. Sheard, P.W., Nielsen, K. B., Lal, N., & Cornwall, J. (2019) Structural alterations at the myotendinous junction in elderly and exercised mouse skeletal msucles. Australian and New Zealand Society for Sarcopenia and Frailty Research 2019 Annual Meeting, Sydney, Australia.

75. Stenling, A. K., Moylan, A., Fulton, E., Machado, L. (2019) Effects of a Brief Stair Climbing Intervention on Executive Functions and Mood States in Healthy Young Adults. Poster session presentation at 15th European Congress of Sport & Exercise Psychology., Münster, Germany.

76. Stenling, A., Eriksson Sörman, D., Lindwall, M., Hansson, P., Körning Ljungberg, J., Machado, L. (2019) Moderators of the longitudinal association between physical activity and cognitive function: Findings from the Betula study. Poster session presentation at the International Association of Gerontology and Geriatrics European Region (IAGG-ER) Congress., Gothenburg, Sweden.

77. Tomari, S., Levi, C., Lasserson, D., Quain, D., Valderas, J., Dewey, H., Alan Barber, P.A., Spratt, N., Cadilhac, D., Feigin, V., Zareie, H., Esperon, C., Davey, A., Najib, N., & Magin, P. (2019) The characteristics of patients with possible transient ischemic attack and minor stroke in the Hunter and Manning valley regions, Australia. Australasian Stroke Society Meeting, September 10-13, 2019, Canberra, Australia.

78. Tomari, S., Levi, C., Lasserson, D., Quain, D., Valderas, J., Dewey, H., Alan Barber, P.A., Spratt, N., Cadilhac, D., Feigin, V., Zareie, H., Esperon, C., Davey, A., Najib, N., & Magin, P. (2019) The characteristics of patients with possible transient ischemic attack and minor stroke in the Hunter and Manning valley regions, Australia. SSA 2019 Conference, Canberra, Australia.

79. Tran, T.Q., Regenbrecht, H., & Tran, M.-T. (2019) Am I Moving Along a Curve? A Study on Bicycle Traveling-In-Place Techniques in Virtual Environments. 17th IFIP TC 13 International Conference, Human-Computer Interaction – INTERACT 2019, Paphos. Cyprus.

80. Vemula, P., Jing, Y., Zhang, H., Cicolini, J., Mockett, B., Abraham, W.C., & Liu, P. (2019) Altered brain arginine metabolism with age in the APPswe/PSEN1dE9 mouse model of Alzheimer's disease. 37th International Australasian Winter Conference on Brain Research, Queenstown, New Zealand.

81. Vemula, P., Jing, Y., Zhang, H., Hunt, J.B., Sandusky, L.A., Lee, D.C., & Liu, P. (2019) Shifted brain arginine metabolism to favour polyamine pathway in mice with tauopathy. The 14th International Conference for Alzheimer's and Parkinson's diseases, Lisbon, Portugal.

82. Vlajkovic, S.M., Han, B.M.X., Lin, S.C.Y., Espinosa, K., & Thorne, P.R. (2019) Inhibition of the adenosine A2A receptor mitigates excitotoxic injury in organotypic tissue cultures of the rat cochlea. 56th Inner Ear Biology Workshop, 7-10 September 2019, Padova, Italy.

83. Vlajkovic, S.M., Housley, G.D., & Thorne, P.R. (2019) Adenosine receptors as promising targets for the treatment of sensorineural hearing loss. Inaugural Purine Club meeting, 17 May, 2019, Melbourne, Australia.

84. Walby, J., Waldvogel, H.J., Faull, R.L.M. & Kwakowsky, A. (2019) Quantification of Alzheimer's-induced glutamatergic changes in the human brain. The HOPE-Selwyn Knowledge exchange for Research on Aging, Auckland, New Zealand.

85. Waldvogel, H.J., Arasaratnam, C.J., & Faull, R.L.M. (2019) Contrasting changes in DARPP-32 and calbindin immunoreactivity in striatal medium spiny neurons in Parkinson's disease. International Basal Ganglia Society (IBAGS), 28 April - 2 May, Biarritz, France.

86. Wu, T., Huang, H.Y., Diprose, W., Harvey, J., Ang, T., Pesavento, L., Shah, D., Martinez-Majander, N., Tse, D., Hill, M., Demchuk, A., Ranta, A., Meretoja, A., Fink, J., Strbian, D., Mitchell, P., Winters, S., Tsai, S.T., Kleinig, T., & Barber, P.A. (2019) Repeated endovascular thrombectomy for early recurrent intracranial large vessel occlusion. European Stroke Organisation Conference, May 22-24, 2019, Milan, Italy.

87. Young, J., Langlotz, T., Cook, M., Mills, S., & Regenbrecht, H. (2019) Immersive Telepresence and Remote Collaboration using Mobile and Wearable Devices. 26th IEEE Conference on Virtual Reality and 3D User Interfaces, VR 2019, Osaka, Japan.

88. Zhang, J., Jing, Y., Zhang, H., Bilkey, D.K., & Liu, P (2019) Maternal immune activation alters pre-pulse inhibition and hippocampal nitric oxide synthase in post-natal day 35 and 60 rat offspring. 37th International Australasian Winter Conference on Brain Research, Queenstown, New Zealand.

89. Zheng, Y., Castro, S., Tan, H., Jones, O. Smith, P. F. & Reynolds, J.N. (2019) Increased synaptic plasticity in the inferior colliculus of rats following acoustic trauma. 37th International Australasian Winter Conference on Brain Research, Queenstown, New Zealand.

90. Zhu, Y., Xie, Y., Huang, K., Liu, P., & Tao. F.B. (2019) Behavioural deficits and hippocampal apoptosis in offspring with prenatal Di-(2-ethylhexyl) phthalate exposure. 37th International Australasian Winter Conference on Brain Research, Queenstown, New Zealand.

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.

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

Mr Tony Offen

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

Professor Jim Metson

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Professor John Rostas

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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.

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

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.

The Venerable Lloyd Nau Pōpata

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Dr Louise Parr-Brownlie

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

Prof. Papaarangi Reid

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

Dr Cameron Lacey

MB, ChB, PhD, FRANZC (*Te Atiawa*), Senior Lecturer at the Māori Indigenous Health Institute at the University of Otago, psychiatrist, and medical director for Westcoast DHB.

Te Kaanga Skipper

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

Piripi Daniels

(*Te Rarawa and Tainui*), A Kaumātua, formerly with Whitiki Maurea Mental Health and Addictions and Kaunihera Kaumātua WDHB

Directorate

Professor Wickliffe Abraham

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

Professor 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

Associate Professor Lynette Tippett

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

Professor 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

Distinguished Professor Sir Richard Faull

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

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- Neurology with special interest in Parkinson's disease

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- Cellular and molecular neuroscience

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- Māori strategic advisor
- MBChB, FRANZCP, PhD

Operations

Alex Sweetman Business Manager
Neka Kater Administrator
Dianne Stacevicius Research Administrator

Ella Fischer Marketing Advisor
Dr Dean Robinson Research Operations Manager

Dementia Prevention Research Clinics

AUCKLAND

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Karelia Levin
Marie Goulden

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Dr Nick Cutfield
Associate Prof Joanna Williams
Tina Edgar
Annabel Dawson
Debra McNamara

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
Alan Barber	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	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	Prof	Auckland University of Technology	Principal Investigator
Denise Taylor	Prof	Auckland University of Technology	Principal Investigator
Andrew Clarkson	Associate Prof	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	Associate Prof	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	Associate Prof	University of Otago	Principal Investigator
Tracy Melzer	Dr	University of Otago	Principal Investigator
Pauline Norris	Prof	University of Otago	Principal Investigator
Louise Parr-Brownlie	Associate Prof	University of Otago	Principal Investigator
Richie Poulton	Prof	University of Otago	Principal Investigator

NAME	POSITION TITLE	INSTITUTION	BRNZ STATUS
Holger Regenbrecht	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
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
Michelle Glass	Prof	University of Otago	Associate Investigator
Andrea Kwakowsky	Dr	University of Auckland	Associate Investigator
Simon O'Carroll	Dr	University of Auckland	Associate Investigator
Cris Print	Prof	University of Auckland	Associate Investigator
Henry Waldvogel	Associate Prof	University of Auckland	Associate Investigator
Rita Krishnamurthi	Associate Prof	Auckland University of Technology	Associate Investigator
Anne-Marie Jackson	Associate Prof	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
Ari Bok	Dr	Auckland District Health Board	Associate Investigator
Catherine Morgan	Dr	University of Auckland	Associate Investigator

Postdoctoral Fellows

NAME	POSITION TITLE	INSTITUTION
Divya Adhia	Post-doctoral fellow	University of Otago
Mustafa Almuqbel	Post-doctoral fellow	University of Otago, Christchurch
Christine Arasaratnam	Post-doctoral fellow	University of Auckland
Ashik Banstola	Post-doctoral fellow	University of Otago
Meagan Barclay	Post-doctoral fellow	University of Auckland
Indranil Basak	Post-doctoral fellow	University of Otago
Rebekah Blakemore	Post-doctoral fellow	University of Otago
Victor Borges	Post-doctoral fellow	University of Auckland
Nadia Borlase	Post-doctoral fellow	NZBRI Ltd
Karen Brewer	Post-doctoral fellow	University of Auckland
Felicity Bright	Post-doctoral fellow	Auckland University of Technology
Juliette Cheyne	Post-doctoral fellow	University of Auckland
John Cirillo	Post-doctoral fellow	University of Auckland
Victor Dieriks	Post-doctoral fellow	University of Auckland
Beth Elias	Post-doctoral fellow	NZBRI Ltd

NAME	POSITION TITLE	INSTITUTION
Daniel Exeter	Post-doctoral fellow	University of Auckland
Fiva Fa'alau	Post-doctoral fellow	University of Auckland
Erika Freemantle	Post-doctoral fellow	University of Auckland
Peter Freestone	Post-doctoral fellow	University of Auckland
Teena Gamage	Post-doctoral fellow	University of Auckland
Matthew Hall	Post-doctoral fellow	University of Otago
Renee Handley	Post-doctoral fellow	University of Auckland
Kyla Horne	Post-doctoral fellow	University of Otago, Christchurch
Deidre Jansson	Post-doctoral fellow	University of Auckland
Owen Jones	Post-doctoral fellow	University of Otago
Staverton (Tony) Kautoke	Post-doctoral fellow	Counties Manukau Health
Dionghyo Joseph Kim	Post-doctoral fellow	University of Otago
Marijn Kouwenhoven	Post-doctoral fellow	University of Otago
Kevin Lee	Post-doctoral fellow	University of Auckland
Klaus Lehnert	Post-doctoral fellow	University of Auckland
Sue Lord	Post-doctoral fellow	Auckland University of Technology
Victoria Low	Post-doctoral fellow	University of Auckland
Michael MacAskill	Post-doctoral fellow	NZBRI Ltd
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Nasim Mehrabi	Post-doctoral fellow	University of Auckland
Alexandr Merkin	Post-doctoral fellow	Auckland University of Technology
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Alexandre Mouravlev	Post-doctoral fellow	University of Auckland
Suzie Mudge	Post-doctoral fellow	Auckland University of Technology
Helen Murray	Post-doctoral fellow	University of Auckland
Daniel Myall	Post-doctoral fellow	NZBRI Ltd
Pritika Narayan	Post-doctoral fellow	University of Auckland
Shane Ohline	Post-doctoral fellow	University of Otago
Sharon Olsen	Post-doctoral fellow	Auckland University of Technology
Leah Palaper	Post-doctoral fellow	University of Auckland
Thomas Park	Post-doctoral fellow	University of Auckland
Yue (Echo) Pei	Post-doctoral fellow	University of Canterbury
Usman Rashid	Post-doctoral fellow	Auckland University of Technology
Ravindra Reddy	Post-doctoral fellow	University of Auckland
Reece Roberts	Post-doctoral fellow	University of Auckland
Brigid Ryan	Post-doctoral fellow	University of Auckland
Margaret Ryan	Post-doctoral fellow	University of Otago
Phil Sanders	Post-doctoral fellow	University of Auckland
Nicola Saywell	Post-doctoral fellow	Auckland University of Technology
Lucia Schweitzer	Post-doctoral fellow	University of Otago
Emma Scotter	Post-doctoral fellow	University of Auckland
Sonja Seeger-Armbruster	Post-doctoral fellow	University of Otago
Lin Shelly	Post-doctoral fellow	University of Auckland
Reza Shoorangiz	Post-doctoral fellow	NZBRI Ltd
Nada Signal	Post-doctoral fellow	Auckland University of Technology
Anurag Singh	Post-doctoral fellow	University of Otago
Malvindar Singh-Bains	Post-doctoral fellow	University of Auckland
Marie-Claire Smith	Post-doctoral fellow	University of Auckland
Leon Smyth	Post-doctoral fellow	University of Auckland

NAME	POSITION TITLE	INSTITUTION
Andreas Stenling	Post-doctoral fellow	University of Otago
Louise Stubbing	Post-doctoral fellow	University of Auckland
Haruna Suzuki-Kerr	Post-doctoral fellow	University of Auckland
Vanda Symon	Post-doctoral fellow	University of Otago
Martha Tarczyluk	Post-doctoral fellow	Independent Aotearoa Fellow
Rachael Taylor	Post-doctoral fellow	University of Auckland
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Raviindra Telang	Post-doctoral fellow	University of Auckland
Conor Underwood	Post-doctoral fellow	University of Otago
Nico Vautrelle	Post-doctoral fellow	University of Otago
Virginia Warriner	Post-doctoral fellow	Te Whare Wānanga o Awanuiārangi
Julie Wharewera-Mika	Post-doctoral fellow	University of Auckland
Angela Wu	Post-doctoral fellow	University of Auckland
Jane Wu	Post-doctoral fellow	University of Auckland
Song Yang	Post-doctoral fellow	University of Auckland
Hu Zhang	Post-doctoral fellow	University of Otago

Students

STUDENT NAME	LEVEL OF STUDY	UNIVERSITY
Ramya Murali Adiseshan	Other	University of Auckland
Matthew Adye	Other	University of Auckland
Sara Ahmed	Doctoral Degree	University of Otago
Ashkan Akland	Doctoral Degree	University of Auckland
Gemma Alder	Doctoral Degree	Auckland University of Technology
Mustafa Almuqbel	Doctoral Degree	University of Otago
Phoebe Anscombe	Other	University of Auckland
Christine Arasaratnam	Doctoral Degree	University of Auckland
Jonathan Armstrong	Doctoral Degree	Auckland University of Technology
Jury Arthur	Other	University of Otago
Chris Attwood	Other	University of Otago
Tin Aung Kyaw	Doctoral Degree	University of Auckland
Micah Daniel Austria	Doctoral Degree	University of Auckland
Saiful Azmi	Other	University of Auckland
Ashleigh Baker**	Doctoral Degree	University of Auckland
Duncan Bakkie	Doctoral Degree	University of Auckland
Mahima Bansal	Doctoral Degree	University of Auckland
Eddie Barnett	Other	University of Otago
Sophie Barnett**	Doctoral Degree	University of Canterbury
Ashleigh Barrett-Young	Doctoral Degree	University of Otago
Deanna Barwick	Doctoral Degree	University of Otago
Dibash Basukala	Doctoral Degree	University of Canterbury
Anjali Bhatia	Doctoral Degree	Auckland University of Technology
Mozammel Haque Bhuiyan	Doctoral Degree	University of Otago
Elizabeth Binns	Doctoral Degree	Auckland University of Technology
Brittney Black	Doctoral Degree	University of Auckland
Rossana Boni	Other	University of Otago
Navidu Bulathinshala	Other	University of Auckland

STUDENT NAME	LEVEL OF STUDY	UNIVERSITY
Beatriz Calvo-Flores Guzman**	Doctoral Degree	University of Auckland
Justine Camp**	Doctoral Degree	University of Otago
Sergio Castro	Other	University of Otago
Connie Chan	Other	University of Otago
Shikha Chaudhary	Doctoral Degree	Auckland University of Technology
Bhavya Chawdhary	Other	University of Auckland
Siyi (Robert) Chen	Doctoral Degree	University of Auckland
Judith Choi	Other	University of Auckland
Benjamin Chong	Doctoral Degree	University of Auckland
Aimee Chu**	Doctoral Degree	University of Otago
Jody Cicolini	Doctoral Degree	University of Otago
Guy Collier	Doctoral Degree	Auckland University of Technology
Rose Coppard	Other	Auckland University of Technology
Duncan Coutts	Other	University of Otago
Chelsea Cunningham**	Doctoral Degree	University of Otago
Karol Czuba	Doctoral Degree	Auckland University of Technology
Ekta Singh Dahiya	Doctoral Degree	Auckland University of Technology
Odysee Davis	Other	University of Auckland
Emma Deeney	Doctoral Degree	University of Otago
Harry Delany	Other	University of Otago
Tori Diamond**	Other	University of Auckland
Sam Dodd	Other	University of Auckland
Kangning Du	Doctoral Degree	University of Otago
Stuart Duncan	Doctoral Degree	University of Otago
Oluwatobi Eboda **	Doctoral Degree	University of Otago
Nicole Edwards	Doctoral Degree	University of Auckland
Jayarjun Ethiraj	Other	University of Auckland
Anita Barzegar Fallah	Doctoral Degree	University of Otago
Daniel Fallahi	Other	University of Auckland
Dawei Fan	Doctoral Degree	University of Auckland
Simon Feng	Doctoral Degree	University of Otago
Mackenzie Ferguson	Other	University of Auckland
Ben Freschini	Other	University of Otago
Philippa Friary	Doctoral Degree	University of Auckland
Nethra Ganesh**	Doctoral Degree	University of Auckland
Manju Gayarathny	Doctoral Degree	University of Otago
Ann George**	Doctoral Degree	Auckland University of Technology
Kushan Ghandi	Doctoral Degree	University of Otago
Usman Ghani**	Doctoral Degree	Auckland University of Technology
Ashley Gillon	Doctoral Degree	University of Otago
Maddy Glover	Other	University of Otago
Kate Godfrey	Doctoral Degree	University of Auckland
Karan Govindpani	Doctoral Degree	University of Auckland
Anton Green	Other	Auckland University of Technology
Pippa Grierson	Doctoral Degree	University of Auckland
Kevin Griffee	Other	University of Auckland
Genevieve Groult	Other	University of Auckland
Hayley Guiney**	Doctoral Degree	University of Otago

STUDENT NAME	LEVEL OF STUDY	UNIVERSITY
Shweta Haldankar	Other	University of Auckland
Matt Hall	Doctoral Degree	University of Otago
Grace Jessica Hall-McMaster	Doctoral Degree	University of Canterbury
Jenny Hamilton	Doctoral Degree	University of Canterbury
Belinda Han	Other	University of Auckland
Seunga Han	Other	University of Auckland
Ben Hanara**	Other	University of Otago
Ashwini Hariharan	Doctoral Degree	University of Otago
Yuriko Haroen	Other	University of Otago
Grace Heays**	Other	University of Auckland
Chris Heinrich**	Doctoral Degree	University of Otago
Blake Highet	Doctoral Degree	University of Auckland
Erana Hond-Flavell	Doctoral Degree	University of Otago
Joshua Houlton	Doctoral Degree	University of Otago
Roanne Hurley	Doctoral Degree	University of Otago
Mohamed Fasil Ibrahim	Doctoral Degree	University of Otago
Mohammad Irsheid	Doctoral Degree	University of Otago
Bianca Jackson	Doctoral Degree	University of Auckland
Javier Jimenez Martin	Doctoral Degree	University of Otago
Harry Jordan	Doctoral Degree	University of Auckland
Lolomani Kalauta**	Other	University of Auckland
Preet Kaur	Doctoral Degree	Auckland University of Technology
Navjyot Kaur	Other	University of Otago
Allanah Kenny**	Doctoral Degree	University of Canterbury
Soo Hyun Kim	Doctoral Degree	University of Auckland
Qiuyi Kong	Doctoral Degree	University of Otago
Kaushalya Kumarasinge	Doctoral Degree	Auckland University of Technology
Nitika Kumari	Doctoral Degree	Auckland University of Technology
David Kweon	Other	University of Otago
Navneet Lal	Doctoral Degree	University of Otago
Ileana Lameta**	Other	University of Otago
Rebecca Lee	Other	University of Canterbury
Michelle Lee	Other	Auckland University of Technology
Kelan Li	Other	University of Auckland
Megan Livingstone	Doctoral Degree	University of Canterbury
Rhys Livingstone**	Doctoral Degree	University of Otago
Jordan Lloyd	Other	University of Auckland
Jasmine Lock	Doctoral Degree	University of Otago
Shaun London	Other	University of Canterbury
Anna Low	Other	University of Otago
Gigi Low	Other	University of Otago
Si Yin Lui	Other	University of Auckland
Susannah Lumsden	Doctoral Degree	University of Otago
Jena Macapagal	Doctoral Degree	University of Auckland
Charlotte Maeve Dunne	Doctoral Degree	University of Auckland
Laura Marriott	Other	University of Auckland
Alex Martin	Other	University of Otago
Jerin Mathew	Other	University of Otago

STUDENT NAME	LEVEL OF STUDY	UNIVERSITY
Sophie Mathiesen**	Doctoral Degree	University of Otago
Laurel McArthur	Doctoral Degree	University of Auckland
Sam McCullough	Doctoral Degree	University of Auckland
Alice McDouall	Other	University of Auckland
Laura McNamara	Other	University of Auckland
Hannah Mein	Other	University of Otago
Stephanie Mercer	Doctoral Degree	University of Otago
Ngahuia Mita	Doctoral Degree	University of Otago
Caleb Mitchell	Other	University of Otago
Soheila Mohammadyari	Doctoral Degree	Auckland University of Technology
Ruth Monk**	Doctoral Degree	University of Auckland
Ronan Mooney	Doctoral Degree	University of Auckland
Maddison Moore**	Other	University of Otago
Serey Naidoo	Doctoral Degree	University of Auckland
Neda Nasrollahi	Doctoral Degree	University of Otago
Carlene Newall	Doctoral Degree	University of Auckland
Julia Newland	Doctoral Degree	University of Auckland
Jin Ng**	Doctoral Degree	University of Otago
Ayesha Nisar Qureshi	Doctoral Degree	University of Otago
Sharon Olsen	Doctoral Degree	Auckland University of Technology
Nick Palmer	Other	University of Auckland
Thulani Palpagama	Doctoral Degree	University of Auckland
Tone Panassollo	Doctoral Degree	Auckland University of Technology
Hrishikesh (Rishi) Pattabharaman	Doctoral Degree	University of Otago
Giovanni Pedone	Doctoral Degree	University of Otago
Katie Peppercorn	Doctoral Degree	University of Otago
Tyson Perez	Doctoral Degree	University of Otago
Emma Peterson	Doctoral Degree	University of Canterbury
Alix Piebenga	Other	University of Canterbury
Christina Pike	Doctoral Degree	University of Otago
Tukohirangi Pini	Other	University of Otago
Nikita Potemkin	Doctoral Degree	University of Otago
Jordan Quensell**	Other	University of Otago
Alehandrea Raiha Manuel **	Doctoral Degree	University of Auckland
Erik Rajwer	Other	University of Auckland
Geremy Ralston	Other	University of Otago
Ari Alex Ramos	Doctoral Degree	University of Otago
Usman Rashid	Doctoral Degree	Auckland University of Technology
Terina Raureti	Doctoral Degree	University of Otago
Priyanta Ravi	Other	University of Auckland
Rebecka Raymond	Other	University of Otago
Cherry Reihana	Doctoral Degree	University of Auckland
Joyeeta Roy	Doctoral Degree	University of Otago
Nitah Rungrougkul	Other	University of Otago
Isaac Samuels**	Other	University of Auckland
Phil Sanders	Doctoral Degree	University of Auckland
Shruthi Sateesh**	Doctoral Degree	University of Otago
Hannah Scobie	Other	University of Otago

STUDENT NAME	LEVEL OF STUDY	UNIVERSITY
Farid Shehata	Other	Auckland University of Technology
Min Shin	Other	University of Auckland
Leena Shoemaker	Doctoral Degree	University of Otago
Vasu Singh	Other	University of Otago
Nicola Slater	Doctoral Degree	University of Canterbury
Te Waka Smit**	Other	Auckland University of Technology
Hazel Smith	Other	University of Otago
Joscelin Smith	Doctoral Degree	University of Auckland
Nicholas Smith	Other	University of Auckland
Simian Snyder	Other	University of Otago
Jennifer Song	Doctoral Degree	University of Auckland
Elizabeth Southward	Other	University of Otago
Meg Spriggs**	Doctoral Degree	University of Auckland
Megan Stark	Doctoral Degree	University of Otago
Taylor Stevenson**	Doctoral Degree	University of Auckland
Ryan Sutcliffe**	Doctoral Degree	University of Otago
Molly Swanson **	Doctoral Degree	University of Auckland
Lenore Tahara-Eckl	Doctoral Degree	University of Auckland
Aroaro Tamati	Doctoral Degree	University of Otago
Adelie Tan	Other	University of Auckland
Sierra Tane	Doctoral Degree	University of Auckland
Sivaporn (Tina) Tasananukorn	Doctoral Degree	University of Canterbury
Kathryn Todd**	Other	University of Auckland
Zhean Tonacao	Other	University of Otago
Clinton Turner	Doctoral Degree	University of Auckland
Dunja Vajsakovic	Doctoral Degree	University of Auckland
Kathryn van der Zanden	Other	University of Auckland
Lisa van Halderen	Other	University of Otago
Pranav Vemula	Doctoral Degree	University of Otago
Leticia Vizor	Doctoral Degree	University of Auckland
Yuktiben Vyas	Doctoral Degree	University of Auckland
Corey Wadsley	Doctoral Degree	University of Auckland
Josh Walby	Other	University of Auckland
Lucy Wales-Earl	Other	University of Otago
Edgar Wallace	Doctoral Degree	University of Auckland
Ao Wang	Other	University of Auckland
Catherine Webb	Doctoral Degree	University of Auckland
Joshua Wensley	Other	University of Otago
Courteney Westlake	Other	University of Otago
Jai Whelan**	Other	University of Otago
Hannah White	Other	University of Otago
Finn Whittington	Other	University of Otago
Jeanette Wikaira	Doctoral Degree	University of Otago
Jasmyn Williams**	Other	University of Otago
Gina Wilson	Other	University of Otago
Kaitlin Wolfe	Doctoral Degree	University of Otago
Giselle Wong	Other	University of Auckland
Zoe Woolf	Other	University of Auckland
Alexander Woolrych	Other	University of Otago
Jane Wu	Doctoral Degree	University of Auckland
Yi-Han Wu	Doctoral Degree	University of Auckland
Tingkai (Tim) Xie	Other	University of Canterbury
Panzao Yang	Doctoral Degree	University of Auckland
Jason Yeung	Other	University of Auckland
Shanshan Yuan	Other	University of Otago
He (Emily) Yuanyuan**	Doctoral Degree	University of Otago
Claudia Zagreanu	Doctoral Degree	Auckland University of Technology
Aisya Zamri	Other	University of Otago
Ying Zhai	Other	University of Auckland
Jiaxian Zhang	Doctoral Degree	University of Otago

*** denotes students who have received direct funding from Brain Research New Zealand*

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OUR PARTNER UNIVERSITIES

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

OUR COLLABORATORS

National

- Ageing Well, National Science Challenge
- Alzheimer's New Zealand
- Auckland District Health Board
- Audiology - Canterbury
- Brain Health Research Centre
- Cancer Society Tissue Bank, University of Canterbury
- Canterbury District Health Board
- Centre for Brain Research
- Counties Manukau District Health Board
- Ferrier Institute, Victoria University
- KEDRI - AUT
- Manaaki Whenua - Landcare Research
- 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, Otepoti (Dunedin)
- Southern District Health Board
- Te Kura Kaupapa Māori o Hoani Waititi
- University of Otago, Cancer Society Tissue Bank
- Waitemata District Health Board

International

- Anhui Medical University, China
- Australian Catholic University, Australia
- Australian Neuroscience Society
- China Pharmaceutical University, China
- Comenius University of Bratislava, Slovakia
- Duke-NUS Medical School, Singapore
- Frankfurt University, Germany
- Fudan University and Huashan Hospital, Shanghai, China
- IBM Research, Healthcare and LIfe Sciences Research, USA
- Imperial College London, UK
- Keck School of Medicine of USC, University of Southern California, USA
- Korea Institute of Science and Technology ("KIST"), South Korea
- Macquarie University and Centre of Excellence for Alzheimers disease research and care, Australia
- Macquarie University, Sydney
- Melbourne Neuroscience Centre, Australia
- National Institute on Aging, NIH, USA
- Neurology Department of Ruijin Hospital, Shanghia, China
- North Carolina State University, USA
- Okinawa Institute for Science and Technology, Japan
- Pomona College, USA
- Rosalind Franklin University of Medicine and Science, U.S.A.
- Shanghai Mental Health Center, China
- Sheffield University, UK
- Texas A&M University, USA
- 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 Copenhagen, Denmark
- University of Gothenburg, Sweden
- University of Newcastle, Australia
- University of Queensland, Australia
- University of Southern Denmark, Denmark
- University of Sydney, Australia
- University of Texas, Austin, USA
- University of Utah, USA
- University of Western Australia
- University of Windsor, Ontario, Canada
- Vrije Universiteit Amsterdam Medical Center, Netherlands
- Western Sydney University, Australia

FINANCIAL STATEMENT

FUNDING SUMMARY FOR THE YEAR ENDED 31 DECEMBER 2019

	2019
Funding Received	($000)
Tertiary Education Commission grant	4,972
Surplus/Deficit carried forward	260
Total Funding received	**5,332**
Expenditure[2]	
Salaries	1,962
Overheads	1,893
Project costs	935
Postgraduate students	528
Travel	268
Extraordinary Expenditure[3]	28
Subcontractors[4]	291
Total Expenses	**5,906**
Net surplus/(Deficit)	**(674)**

*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 2019. 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 2019 BRNZ carried forward a net surplus of 260. This surplus has been added to BRNZ's 2019 income to fund the CoRE's research programme in 2019. BRNZ therefore has a deficit of 674 that will be deducted from the CoRE's 2020 TEC income to fund the last year of expenditure of the CoRE.

TABLE OF STATISTICS

BROAD CATEGORY	DETAILED CATEGORY	YR 5
Value of CoRE funding from TEC ($M)		**$4.972**
FTEs by category	Principal investigators	10.72
	Associate investigators	1.9
	Postdoctoral fellows	16.52
	Research technicians	28.83
	Administrative/support	4.38
	Research students	231.2
	Total	**-**
Headcounts by category	Principal investigators	55
	Associate investigators	17
	Postdoctoral fellows	74
	Research technicians	49
	Administrative/support	15
	Research students	227
	Total	**437**
Peer reviewed research outputs by type	Books	1
	Book chapters	4
	Journal articles	273
	Conference papers	90
	Other	3
	Total	**371**
Value of external research contracts awarded by source ($000)	Vote Science and Innovation contestable funds	$10,109
	Other NZ Government	$77
	Domestic – private sector funding	$420
	Overseas	$1,964
	Other	$3,147
	Total	**$15,717**
Commercial activities	Number of licenses	0
	Income from licenses	0
	Patent applications	0
	Patents granted	1
	Invention disclosures	0
	Number of new spinouts	0
	Capitalisation value of spinouts	0
Students studying at CoRE by level	Doctoral degree	137
	Other	90
	Total	**227**
Number of students completing qualifications by level	Doctoral degree	21
	Other	35
	Total	**56**
Immediate post-study graduate destinations	Further study in NZ	18
	Further study overseas	4
	Employed in NZ	9
	Employed overseas	5
	Unknown	20
	Other	0
	Total	**56**

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UNIVERSITY
AUCKLAND, NEW ZEALAND
Parkinsons New Zealand
STROKE FOUNDATION
ALZHEIMERS NEW ZEALAND
Age Concern
DPRC