




 **NeuRA**  
*Discover. Conquer. Cure.*

# PROFILE 2020

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*It is with your support  
that NeuRA continues  
to make progress  
in addressing brain  
and nervous  
system disorders*

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# CONTENTS

## 4 A message from the CEO

## 7 Ageing and Neurodegeneration

- 8 Overview
- 9 New dementia guidelines for local doctors
- 10 Reducing dementia risk among Aboriginal Australians
- 11 Researchers bring ABC TV show to real life

## 12 Falls, Balance and Injury

- 13 Overview
- 14 NeuRA innovation predicts falls among older people with 75 per cent accuracy
- 15 NeuRA's home exercise app StandingTall is being tested in local communities and overseas
- 16 Using augmented reality to improve cognitive impairment

## 17 Injury Prevention

- 18 Overview
- 19 Driver safety compromised by seat cushions
- 20 Arm rests on car doors proved to do more harm than good for children
- 21 Researchers recommend used child safety seats are thoroughly inspected

## 22 Mental Illness

- 23 Overview
- 24 Researchers are investigating the impact of Instagram on teen mental health
- 25 Team discovers a lack of new brain cells in people with schizophrenia
- 26 Finding the key to mental resilience

## 27 Understanding Pain

- 28 Overview
- 29 Discovery into how chronic pain alters personality
- 30 Self-management solutions to lower back pain
- 31 Proving pain sensitivity can be predicted

## 32 Spinal Cord Injury

- 33 Overview
- 34 Spinal Cord Injury Research Centre offers new hope
- 35 Forging new partnerships to advance spinal cord injury research
- 36 Landmark project begins to help people with paralysis

## 37 Exploring the Brain

- 38 Overview
- 39 NeuRA research supports brain health of NRL players
- 40 The machine for exploring inner space
- 41 Researchers create comprehensive brain atlas

## 42 The NeuRA Community

- 42 A message from the NeuRA Foundation Acting Co-Directors
- 43 Corporate partnerships improve health outcomes
- 44 NeuRA's colourful campaign for mental health
- 45 In the jungle and raising awareness for research
- 45 Team NeuRA at the City2Surf
- 46 NeuRA Boards

# A MESSAGE FROM THE CEO

Thank you for your interest in NeuRA's incredible progress over the past year. Our goal is to tackle some of the biggest health challenges facing Australia and the world. To do this, we combine a wide variety of brain-related research under one roof to ensure our research projects are interconnected and our findings are of greatest impact. Over the past year, NeuRA's studies have led to new discoveries that are helping to improve the lives of our supporters and are addressing some of the biggest health challenges that we, as humans, face.

This past year we have all been impacted by the COVID-19 pandemic which, much like the rest of the world, has been uncharted territory for NeuRA. Regardless of this, we responded accordingly and have successfully adapted our studies and findings so they align more closely with the public health challenge. We are committed to protecting the health of Australians and helping them to overcome this crisis.



## Improving breathing

NeuRA's work on breathing is now especially relevant. We have clinical trials underway that aim to improve breathing and reduce the time a critically ill person stays ventilated in the intensive care unit. We are also rolling out breathing training devices for those with spinal cord injury, who are up to 150 times more likely to get pneumonia than the general public. Both projects have the very real potential to save lives.

The bedrock of our activities is our research in neurodegeneration, mental illness, injury and its prevention, and brain structure. We are looking at how to prevent illness occurring, improve treatment, and support activities aimed at preventing injury and curing diseases such as dementia and schizophrenia.



Professor Peter Schofield AO

Our partnership with government has been deepening. In 2020, the NSW Treasurer Dominic Perrottet and Minister for Health and Medical Research Brad Hazzard opened our new Spinal Cord Injury Research Centre and announced new state government funding for three flagship studies. In addition, our NeuRA Imaging Centre has gone through a major overhaul thanks to the installation of a new state-of-the-art 3 Tesla MRI scanner that is solely for research use. This will enable us to conduct new cutting-edge research.

NeuRA has also expanded its corporate partnerships. We have signed a new three-year agreement with the country's largest road operator, Transurban, to continue our partnership in the Transurban Road Safety Centre. This will allow our scientists to embark on ambitious new research projects that will improve safety for road users throughout the country.



## Examining the impact of rugby on the brain

NeuRA's Sydney Brain Bank has established a new brain donor program to investigate the impact of head injuries on National Rugby League (NRL) players. Our researchers are correlating the brain health and wellbeing of former players with their neuropathology after they have died. This program, driven by the power of linking clinical and pathological data will provide unique insights into the impact of concussion on brain function.

These activities would not have been possible without the generosity of our supporters. In 2019, we launched a community participation campaign called *Colour Your Hair for Mental Health*. Australians and businesses who participated helped NeuRA to expand its work in tackling mental illness.

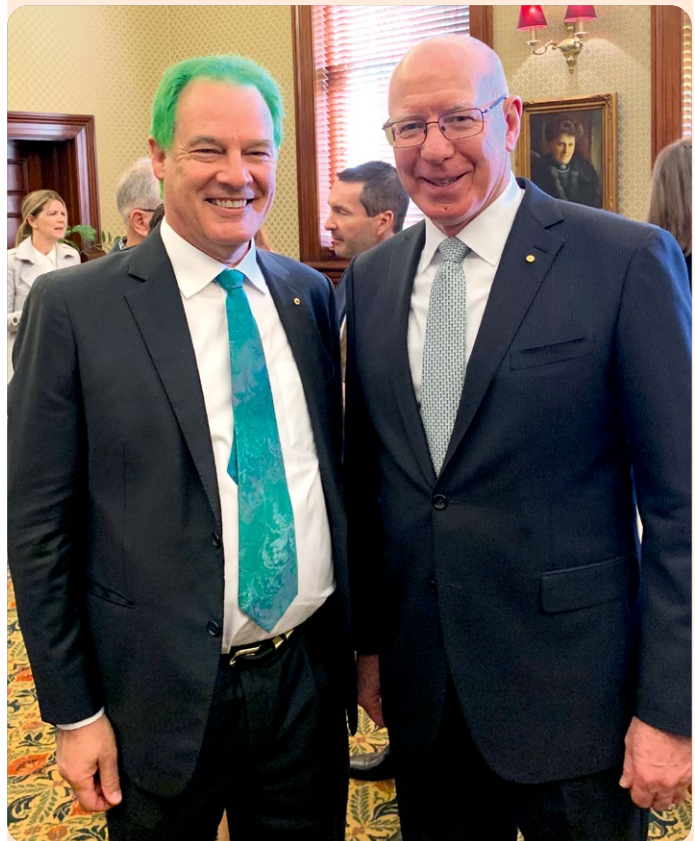
We were privileged to work with a range of Australian personalities who are strong advocates for our research including entertainer, Rhonda Burchmore, comedian Tommy Little, and para-surf champion, Sam Bloom. In addition, the NRL announced a partnership with NeuRA's Sydney Brain Bank to study the brain impacts of sports related concussion. And we are also working to bring the ABC hit series *Old People's Home For 4 Year Olds* to life through a real-world research trial.

Thank you for your support, which enables NeuRA's world-renowned scientists to work tirelessly to make new discoveries to improve the health of all Australians.

Prof Peter R Schofield AO FAHMS PhD DSc  
CEO

## A COLOURFUL FIRST YEAR

The purpose of NeuRA's Colour Your Hair for Mental Health campaign is to make mental illness more visible - quite literally - and less prevalent. In its first year, the campaign had over 2,000 participants and raised \$110,000, which enabled further research into conditions, such as anxiety, depression, bipolar disorder and schizophrenia. It was an incredible outcome and it all came down to the effort and impact our supporters made. I was also fortunate enough to raise awareness of *Colour Your Hair for Mental Health* with the Governor-General of Australia, David Hurley AC, himself!



Professor Peter Schofield AO with the Honourable David Hurley AC DSC (Retd) Governor-General of Australia

# NEURA'S ANNUAL SNAPSHOT

## STAFF

A total of **246** staff,  
over **64%** of whom are female



**34** Research groups

**210**

Research staff and students



**36**

Executive, operations and foundation staff

## PERFORMANCE

**212** active grant awards from 66 funding bodies



**342** publications



**28** clinical trials currently underway

## PUBLIC COMMUNITY AND INVOLVEMENT



people in NeuRA's volunteer registry, including 51 new volunteers in 2019. Our volunteers have participated in **88 projects** to date.

Over

**300**

people involved in technology-based falls prevention programs



**49** brain and

**17** spinal cord



donations, producing over **6500 samples** for research projects



Over

**2000**

participants in the Colour Your Hair for Mental Health campaign



# AGEING AND NEURODEGENERATION



Dr Bill Brooks examining a sample of brain tissue from NeuRA's Sydney Brain Bank

## HEALTH CHALLENGE

Age is the greatest known risk factor for neurodegenerative diseases, which cause problems with cognitive functions, difficulties performing everyday activities and loss of independence.

More than three in ten Australians over the age of 85 live with dementia, many of whom are unable to function on their own. Brain disorders are life changing for both the person with the illness and their friends and loved ones. Symptoms typically become progressively worse and lead to death. Alarmingly, there is currently no cure for brain illnesses like dementia.

The economic burden of dementia is huge, and is exacerbated by Australia's ageing and growing population. The cost to the Australian economy is expected to reach \$18.7 billion by 2025 and \$36.8 billion by 2056.



## NEURA'S ACTION

NeuRA's findings are helping people to change their lifestyles so that they reduce their risk of dementia. This includes guidance around diet, smoking and alcohol consumption, cognitive, physical and social activity and avoidance of environmental risks such as pollution. Our research is helping us to understand and potentially target the underlying causes of neurodegenerative diseases. For example, we are examining the genetics of certain families to determine whether they are more susceptible to these diseases, and whether medication can help prevent brain illnesses occurring.

Our work also looks at aged care, and what can be done for those who are supporting people affected by neurodegeneration. We are working with aged care facilities and Aboriginal and Torres Strait Islander communities to help those who are living with illnesses such as dementia.

## POTENTIAL IMPACTS IN AUSTRALIA

NeuRA’s research is helping Australians reduce the likelihood of neurological decline and increase longevity. Our work examines the factors that contribute to successful ageing with the aim of providing advice on how Australians can increase the likelihood that they will retain their cognitive ability as they age. We have also produced new guidelines for general practitioners and a dementia care intervention for people in residential aged care.

Indigenous Australians are much more likely to develop dementia than the general population, and our studies are advancing the health advice given to Aboriginal and Torres Strait Islanders. We are working closely with rural and urban Aboriginal communities to share our latest research and develop better health outcomes for these groups.

NeuRA is also studying familial Alzheimer’s disease and collaborating with national and international

institutes on these projects. Families where Alzheimer’s disease is caused by an inherited genetic mutation are rare but have a vital role to play in advancing our understanding of the disease process. Brain scans and other biomarkers of early disease activity have led to prevention trials in this rare group of people, but the insights gained should lead in time to more widely available preventive measures.

More than **500,000** people in Australia have dementia and there are **250** new diagnoses each day. These diagnoses are expected to rise to over **300 per day** within the next five years



Currently, over **1.5 million** Australians provide care to someone living with dementia. By 2036, the total cost of dementia in Australia is predicted to increase by **81%**



There are also in excess of **100,000** Australians living with Parkinson’s disease



In approximately **85%** of dementia and Parkinson’s disease cases, the cause is unknown.



## SNAPSHOT OF CURRENT RESEARCH

**Dementia risk assessment tools and advice:** using big data approaches to develop practical online tools for clinicians and the general public, to assess risk factors for dementia and related chronic diseases and associated advice.

**The Dominantly Inherited Alzheimer Network (DIAN):** has identified biomarkers for Alzheimer’s disease that are detectable long before initial clinical symptoms become apparent. These are now being used in clinical trials to prevent or delay dementia in people carrying a genetic mutation causing familial Alzheimer’s disease.

**Our MOB Study:** neuroimaging to investigate social and biomedical risk factors, and underlying causes of dementia with older Aboriginal Australians.

**The Audacious study:** investigating important links between hearing loss and cognitive decline.

**BPSD PLUS:** a person-centered approach to managing behavioural and psychological symptoms of dementia in residential care.





## NEW DEMENTIA GUIDELINES FOR LOCAL DOCTORS

**D**id you know around 15 per cent of dementia cases globally could be prevented through simple lifestyle changes that can be recommended by a local doctor?

Professor Kaarin Anstey, a Senior Principal Researcher at NeuRA and ARC Laureate Professor at UNSW, and Dr Ruth Peters, a senior scientist at NeuRA have recently created a new set of guidelines that provides better guidance to doctors on how to care for people who are at risk of developing dementia.

“Many Australians don’t realise they can effectively reduce their risk of developing dementia. These guidelines will equip general practitioners with evidence-based guidance on modifiable risk factors in mid and late life to help them provide better care to their local communities,” said Professor Anstey.

The risk factors covered in the guidelines include diet, alcohol consumption, physical activity, smoking, sleep, obesity and medical conditions.

“Local doctors are well positioned to play a significant role in dementia risk reduction. They see people with multiple risk factors and, by using these new recommendations, can ensure patients receive the earliest possible care and advice to reduce their risk of cognitive decline and dementia,” said Professor Anstey.

Professor Anstey’s research team was one of the two teams globally that developed the evidence briefs for the 2019 World Health Organisation’s Guidelines on Risk Reduction for Cognitive Decline and Dementia.

***The risk factors covered in the guidelines include diet, alcohol consumption, physical activity, smoking, sleep, obesity and medical conditions.***

# REDUCING DEMENTIA RISK AMONG ABORIGINAL AND TORRES STRAIT ISLANDER AUSTRALIANS

Dementia is a significant health challenge for Aboriginal and Torres Strait Islander peoples, as they are three to five times more likely to develop the condition than the general Australian population.

A recent study by NeuRA’s Dr Kylie Radford found there are a number of factors that are associated with dementia risk in urban and rural Aboriginal communities. Those who are more likely to be diagnosed with Alzheimer’s disease and other forms of dementia include people who were exposed to early life stress and adversity (including survivors of the “Stolen Generations”), had fewer opportunities to engage in education and skilled employment throughout their lifetime, experienced a stroke or traumatic brain injury in mid-late life, or who have a history of epilepsy.

To improve dementia prevention with Aboriginal Australians, Dr Radford’s team worked with over 300 older Aboriginal people and Elders across New South Wales, many of whom were in good health despite their old age. Through surveys and interviews, researchers gathered data on the factors these Elders felt had contributed to their own



NeuRA researcher and Gumbaynggirr and Biripi Elder, Mr Terry Donovan, presenting the findings of the report

wellbeing and longevity.

The results of this six-year study show that Elders identified seven primary areas that contribute to ageing well within these Aboriginal communities, including:

- Connections to Country and culture.
- Respecting yourself, the Elders and all the Mob.
- Resilience.
- Getting together, yarning, and passing on knowledge.
- Maintaining physical and emotional health to live a long life.
- Saying “no” to smoking, alcohol and drugs.
- Education.



Dr Kylie Radford and Mr Terry Donovan pictured with the *Sharing the Wisdom* team

“With many risk factors for late-life dementia apparent in mid-life and probably even younger, it is important to increase awareness of brain health and dementia risk reduction with people of all ages,” said Dr Radford.

“This was recognised by the Aboriginal communities partnering with NeuRA’s research and led to the *Sharing the Wisdom of Our Elders Project*,” she said.



## RESEARCHERS BRING ABC TV SHOW TO REAL LIFE

In an Australian first, a team of scientists is turning a televised social experiment between older Australians and young children into a real-life research program.



Intergenerational activities on ABC program 'Old People's Home for 4 Year Olds' (ABC supplied)

Inspired by the ABC's television series *Old People's Home For 4 Year Olds*, researchers are investigating how seniors and toddlers can be brought together to impart knowledge and kindle enthusiasm.

The study will involve facilitating face-to-face interaction between adults over the age of 65, who are often living alone or in retirement villages, and children aged three to five years old.

*Old People's Home For 4 Year Olds* gave insight into how intergenerational programs benefit participants. Early research indicates these programs could lead to better

physical health and cognition among older Australians, and better interpersonal skills among children.

"Children and older adults are the perfect companions and can build lovely partnerships where they both really care for each other," said the project leader, Dr Ruth Peters, a senior researcher at NeuRA.

"These two generations often have similar characteristics, such as their levels of openness and curiosity. Older people are often natural teachers and children love learning, which means they'll both benefit from doing activities together," she said.

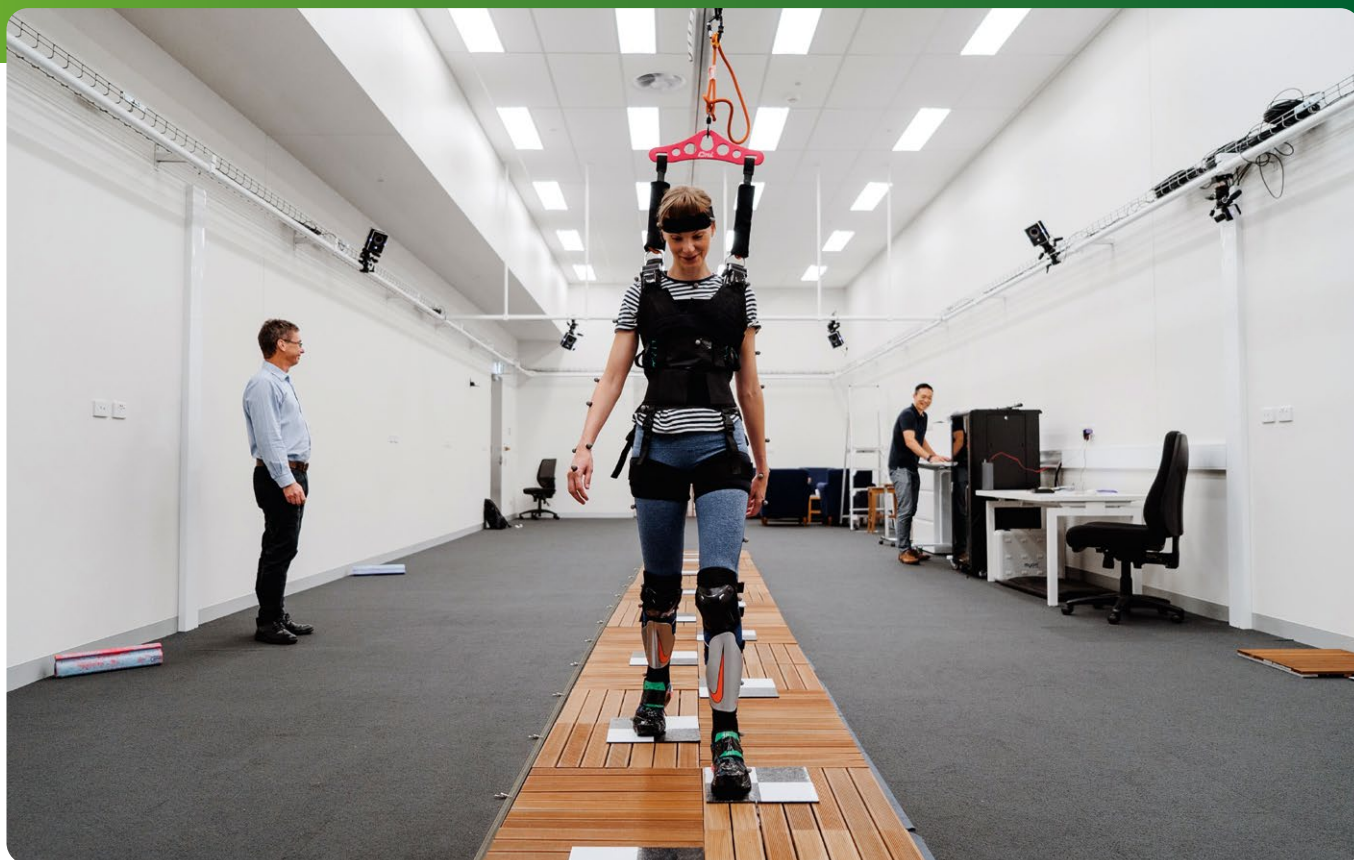
Researchers hope the program will be of particular benefit to those aged 75-84, half of whom live alone, and whose isolation might have been exacerbated by COVID-19.

This project begins with a public survey that will help researchers to learn more about community interest and requirements, such as the type of support that may be needed for older Australians to participate in these kinds of programs.

This survey will be used to shape the real-life study, which will be designed in such a way that it can be easily applied to a range of communities.



# FALLS, BALANCE AND INJURY



Researchers test responses to slip and trip hazards while protecting the study participant with a safety harness

## HEALTH CHALLENGE

Falls are one of the most significant health challenges faced by older people. A serious fall can lead to major health implications, and a persistent fear of falling again.

Some of the typical injuries from serious falls include fractures and traumatic brain injury.

Additionally, falls, unsteadiness or a loss of balance can have major psychological implications. The resulting fear of falling can cause social isolation through limiting every-day activities like seeing family members or going to the shops.

Falls are a growing health challenge in Australia due to our ageing population. By 2051, Australia's fall-related health care costs are predicted to reach a staggering \$1.4 billion annually.



## NEURA'S ACTION

The Falls, Balance and Injury Research Centre at NeuRA is conducting world-leading research to better understand human balance and more effectively prevent falls in older people.

Our research has three priorities that are of benefit to the Australian public:

- 1** We identify fall risk factors in older people and at-risk groups.
- 2** We develop effective and feasible fall prevention strategies.
- 3** We advocate for and help implement evidence-based care for people with a fall-related injury.

## POTENTIAL IMPACTS IN AUSTRALIA

NeuRA's research shows that targeted intervention can reduce fall rates by 20 to 50 per cent. There is now a clear need to implement these interventions widely.

Scale up of our interventions has the potential to prevent falls and improve quality of life in older people and clinical groups with balance disorders, as well as significantly reducing health service costs.

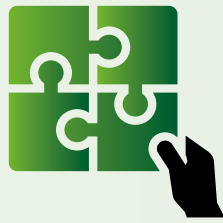
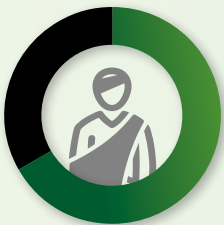
Our fall prevention research:

- Incorporates components from physiology, biomechanics, psychology, physiotherapy, brain imaging and computer software engineering.
- Uses multiple databases of tens of thousands of people to examine trends among healthy and clinical populations, which enables us to identify and

address the factors that lead to serious falls.

- Enhances our understanding of human balance, including the roles that cognitive, sensory and motor abilities, behavioural factors and diseases play in increasing the incidence and severity of falls.

Up to **30%**  
of people who fall  
and break their  
hip **die within 12**  
**months**



NeuRA's  
**FallScreen+** can  
predict falls among  
older people with  
**75% accuracy**

NeuRA's  
**StandingTall** reduces  
someone's risk of  
falling for up to  
**two years**



The Falls, Balance and  
Injury Research Centre  
comprises of **30 years**  
of research involving  
**20,000**  
participants



## SNAPSHOT OF CURRENT RESEARCH

### **StandingTall and StandingTall-Plus:**

home-based balance and cognitive apps designed to reduce fall risk in older people and address fear of falling and depressive thoughts.

### **SmartStep:**

a program that can be done at home by older people and those with neurological conditions, to train the balance and cognitive functions that are crucial for fall prevention.

### **FallScreen+:**

an app-based fall risk assessment tool that accurately estimates fall risk and pinpoints problem areas requiring treatment, including lower limb strength, and reaction time.

### **SmartSocks:**

a new technology garment being tested to assess impact on walking stability in people with Parkinson's disease.

### **Australian and New Zealand Hip Fracture Registry (ANZHFR):**

provides hospitals with real-time performance data on hip fracture care, allowing them to see how they perform against other hospitals.

# NEURA INNOVATION PREDICTS FALLS AMONG OLDER PEOPLE WITH 75 PER CENT ACCURACY

NeuRA partnered with Mark Moran Group (MMG) to test our new *FallScreen+* app-based wellbeing assessment tool.



Research participant completes the balance component of *FallScreen+*

**F***allScreen+* can predict falls among older people with 75 per cent accuracy, which could be a game changer for how we identify risk and prevent falls.

### How will *FallScreen+* help Australians?

The tool is based on more than 30 years of NeuRA’s research involving over 20,000 participants.

The *FallScreen+* app tests people aged over 60 years for health markers that are vital to their independence and wellbeing.

*FallScreen+* is unique because it screens issues early on, flags problem areas and makes recommendations for effective treatment strategies to address potential health problems.

### How did NeuRA work with the Mark Moran Group?

“MMG is investing funds and the time of its staff and residents to help NeuRA generate the best possible app for the Australian public,” said NeuRA’s project lead, Professor Stephen Lord.



NSW Health Minister Brad Hazzard unveiled *FallScreen+* at NeuRA

“*FallScreen+* was trialed at MMG facilities to measure the wellbeing and health status of residents. It is essential that we test this app in a controlled, real-world environment, so that we can optimise the product before it becomes publicly available,” he said.

“By working with NeuRA, we’re demonstrating our commitment to making sure the latest innovations are available to all older Australians to help them age well,” said MMG Co-Founder, Mark Moran.

Results from trialing the *FallScreen+* app are being assessed by NeuRA researchers. Our vision is to make the tool available for those who work in the aged care sector, such as physiotherapists, occupational therapists, exercise physiologists, and fall prevention clinicians and researchers.



## NEURA'S HOME EXERCISE APP *STANDINGTALL* IS BEING TESTED IN LOCAL COMMUNITIES AND OVERSEAS

In a national first, healthcare workers in Australia are using our new clinically-tested home exercise app *StandingTall* to improve balance and reduce falls among older members of the community.

The app is being used by three local area health precincts in NSW and Victoria as part of real-world clinical testing with patients across Australia.

“Our goal is for the app to be released publicly to all Australians,” said NeuRA principal researcher Associate Professor Kim Delbaere.

Results show that those who use *StandingTall* for two hours each week reduce their risk of falling for up to two years.

### How does *StandingTall* work?

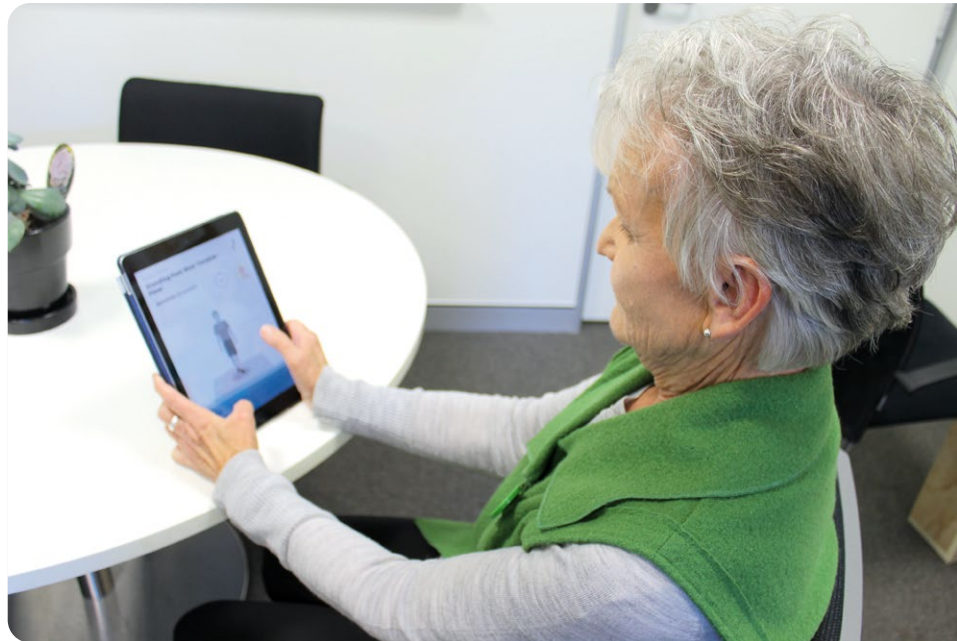
*StandingTall* features over 6000 exercises vetted by clinicians and enables people to engage in their own, personalised home exercise program.

It automatically provides data to health workers, enabling them to review a person's progress and provide more informed treatments, if required.

“*StandingTall* is so easy to use and is loved by the people in our trial. What sets it apart from other exercise apps is that has been co-designed by scientists, older people and health practitioners using the latest findings in neuroscience to improve people's lives,” said Associate Professor Delbaere.

### What are the next steps?

There have already been early successes among older Australians. At the age of 85, Harold Burman has recovered from a detrimental fall and said goodbye to his walker thanks to *StandingTall*.



Aged care resident completes the Sit-to-Stand Test

“I started off doing ten minutes a day and gradually increased my time over the course of a few weeks. In fact, prior to my fall, I used a walking stick to get around. But as I used the app, I felt surer and more stable and needed my stick less,” Mr Burman said.

NeuRA is now exploring options with potential corporate partners and health bodies on how to distribute this app, which has the potential to dramatically help people as they age.

**Our goal is  
for the app to  
be released  
publicly to all  
Australians**

NEURA PRINCIPAL  
RESEARCHER ASSOCIATE  
PROFESSOR KIM DELBAERE

## USING AUGMENTED REALITY TO IMPROVE COGNITIVE IMPAIRMENT

Mild Cognitive Impairment (MCI) is the state between normal age-related cognitive changes, such as slightly slowed processing speed, and the earliest signs of dementia, where memory, concentration and confusion start to become problematic.

**MCI** currently affects around 16 per cent of older people who are living in communities throughout Australia. While some people with this condition remain stable, and potentially even improve, others experience progressive cognitive decline and eventually deteriorate into a state of dementia.

Recent evidence also indicates that cognitive disorders increase a person's susceptibility to falls. In fact, the findings suggest cognitively impaired people are about twice as likely to fall than cognitively-intact older people.

Despite their proneness, preventive falls strategies for this population do not currently exist.

NeuRA researchers believe it is likely that cognitive impairment leads to a reduction in the mental resources required to navigate different environments, thereby increasing the person's risk of falling.

To develop a solution, Professor Stephen Lord and his team are using Augmented Reality (AR) to assess how older people interact with their surroundings.

"AR offers a hologram-like virtual experience and allows us to replicate everyday life situations, such as walking on a busy street," said Professor Lord.

"Using this technology, we can measure the participant's ability to recognise and avoid hazards," he said.

For instance, AR will help researchers to train the perceived foot-to-obstacle distance that is critical for preventing falls.

"This project will give people with MCI the ability to allocate attention and avoid unpredictable hazards in everyday life," said Professor Lord.



# INJURY PREVENTION



Footage of a crash test dummy during a simulated road crash in the Transurban Road Safety Centre

## HEALTH CHALLENGE

Injury is the leading cause of death for people under the age of 45.

Additionally, non-fatal injuries can leave a lasting legacy, with many people experiencing complications that lead to lifelong disability or premature death.

Road accidents are one of the most common causes of serious injury in Australia. Since 2003, hospitalised injury among drivers, passengers, motorcyclists, pedal cyclists and pedestrians has increased each year by over three per cent.



## NEURA'S ACTION

To combat the prevalence of motor vehicle injuries in Australia, NeuRA conducts studies into road safety in the state-of-the-art Transurban Road Safety Centre. The Centre is Australia's only research-dedicated crash test lab and contains a crash sled that can travel at over 60 kilometres per hour.

The facility enables researchers to simulate different types of vehicle accidents that can occur on our roads. Their goal is to understand how we can improve vehicle and road safety to better protect all Australians.



## POTENTIAL IMPACTS IN AUSTRALIA

NeuRA’s researchers conduct a wide range of tests to help provide safety advice to road users, governments, motoring bodies and manufacturers.

In the past year alone, our research into injury prevention has:

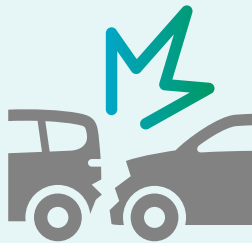
- Demonstrated that there is a safety benefit to using plastic chest clips in child car restraints. These clips are currently not available on Australian restraints.

- Highlighted the safety risks caused by car accessories such as cushions, which are commonly used by older drivers to improve comfort.
- Found that children using a car seat incorrectly are three times more likely to die or suffer a serious injury during a car crash.

**Children using a car seat incorrectly are three times more likely to die or suffer a serious injury**

### Injury is the leading cause of death

among people aged 1 to 44 years.



**For children, road transport crashes are the leading cause of injury related death,** with passengers of motor vehicles accounting for approximately half of these.

### Older motorists are at up to 9 times higher risk

of serious injury in a crash than younger adults, and the number of injured older motor vehicle occupants is increasing.



In 2019 there were



**road crash deaths,** an increase of

**5.3%** from 2018



## SNAPSHOT OF CURRENT RESEARCH

### Producing guidelines for comfort accessories for older drivers:

helping consumers to understand which accessories, such as cushions and back supports, are safest to have inside a vehicle.

### Examining design of arm rests and potential safety risks:

exploring how the position of an arm rest can cause injury to a passenger during a side-on collision.

### Motorcycle fuel tank testing:

examining whether the design of motorcycles and position of the fuel tank can be modified to improve safety to motorcyclists.

### Testing the safety of old child restraints:

examining whether child restraints that are older than the expiry date of the manufacturer’s warranty could still be used safely.

### Developing an updated child restraint test setup:

Designing a new crash test setup for child restraints that matches the geometry and characteristics of the rear seat of modern vehicles, and also simulating how a door moves inwards during a side crash.

### Comparing the safety of different restraints for older children:

examining whether booster seats or forward facing child restraint are safer for children aged 4-8 years.

## DRIVER SAFETY COMPROMISED BY SEAT CUSHIONS

Pillows are commonly used by older drivers to make travelling more comfortable. In fact, around one quarter of older Australians use a pillow to sit on or lean against while driving.

Despite this, there exists no information on whether these accessories can safely be used.

To identify the potential danger they pose, researchers ran over 130 crash tests at NeuRA's Transurban Road Safety Centre. They assessed the impact of seat base cushions, seat back cushions, back support and head-rest cushions, and found these accessories increase the likelihood of injury during crash.

"The results show these aftermarket accessories change the geometry of a seatbelt, the posture of a driver, and increase the chance of chest injury in a crash," said Associate Professor Julie Brown, Co-Director of the Transurban Road Safety Centre at NeuRA.

"It's of concern for older people because they are nine times more likely to get hurt during a crash. Our findings demonstrate the need to provide better guidance for older drivers on how to both be comfortable and safe while behind the wheel," she said.

Transurban Road Safety Centre researchers are now taking their findings to clinicians, motor vehicle safety experts and older drivers to develop a set of safety recommendations about how to safely use these accessories in cars and which ones not to use.



Some of the accessories used by older drivers, which can increase chance of injury during a crash

***The results show these aftermarket accessories change the geometry of a seatbelt, the posture of a driver, and increase the chance of chest injury in a crash***

ASSOCIATE PROFESSOR JULIE BROWN,  
CO-DIRECTOR OF THE TRANSURBAN ROAD  
SAFETY CENTRE AT NEURA





## ARM RESTS ON CAR DOORS PROVED TO DO MORE HARM THAN GOOD FOR CHILDREN

Armrests on doors were invented to make the travelling experience more luxurious and comfortable. However, NeuRA researchers have found that the position of arm rests pose a health risk for child passengers.

Co-director of NeuRA's Transurban Road Safety Centre, Associate Professor Julie Brown, has discovered that the height of the arm rest can increase the likelihood of a child having a head injury during a crash by up to 52 per cent.

"This is the first time Australian researchers have been able to examine how child restraints function when there is an intrusion of the door from a side impact," said Associate Professor Brown.

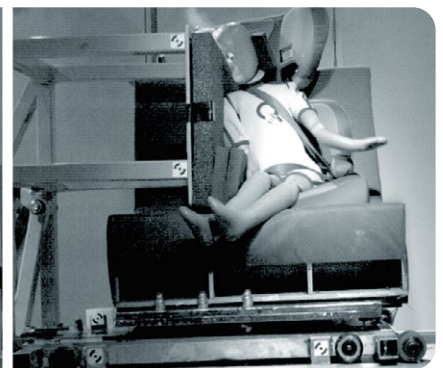
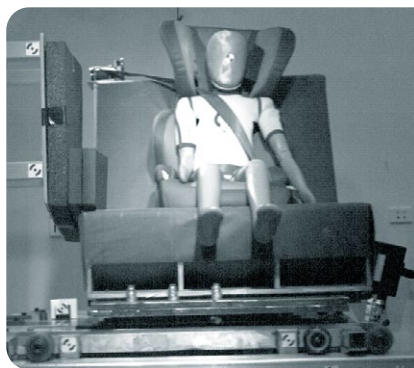
The researchers found that the position of the arm rest alters the movement of booster seats, which can influence head injury risk. A mid-height armrest was found to be most problematic compared to both low and high armrests. A door with no armrest was the safest option.

"This is an important development because side impact crashes are responsible for most of the serious head injury that occurs to correctly-restrained children," said Associate Professor Brown.

"We have the opportunity to increase safety in cars by improving the shape of the armrest and door.

This would make it less likely that a side-on collision will result in death or serious injury of a child," she said.

Researchers at the Transurban Road Safety Centre are now looking to test rear door shapes commonly found in cars on Australian roads to determine which designs are safest.



Testing the efficacy of arm rests on car doors in a side-on crash



## RESEARCHERS RECOMMEND USED CHILD SAFETY SEATS ARE THOROUGHLY INSPECTED

Researchers have found that despite heavy use, sun exposure, and general wear and tear, older child safety seats still perform well in simulated frontal crashes.

The findings by NeuRA researchers at the Transurban Road Safety Centre show that older restraints will protect a child occupant in a crash, providing they have not already been in a serious road accident.

The researchers found that some restraints were damaged during the testing in a way that would impair their performance in any subsequent crashes.

“In our laboratory crash testing, we found that these seats were effective in protecting child passengers from head and abdominal injuries,” said Dr Tom Whyte, an injury biomechanics engineer and postdoctoral researcher at NeuRA.

“However, the force of the crash damaged some child safety seats so badly that they would not offer the same level of protection if they were involved in another crash later on.”

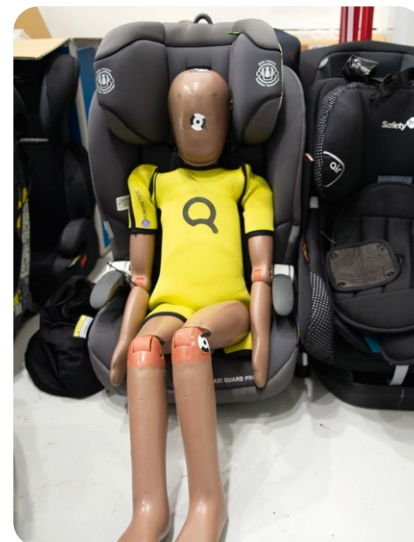
The researchers tested used car seats up to 23 years old, including rearward-facing, forward-facing and booster seats in frontal crash tests. This included ex-rental seats that had been well-used.

Researchers say these findings highlight the importance of used seats being thoroughly inspected to ensure a child safety seat is in good condition and not missing any parts. But not all damage might be visible or in a place that

can be easily seen. For this reason, researchers caution against using older restraints with an unknown history.

“Used car seats should always be checked to make sure that no critical components are damaged or missing,” said Dr Whyte.

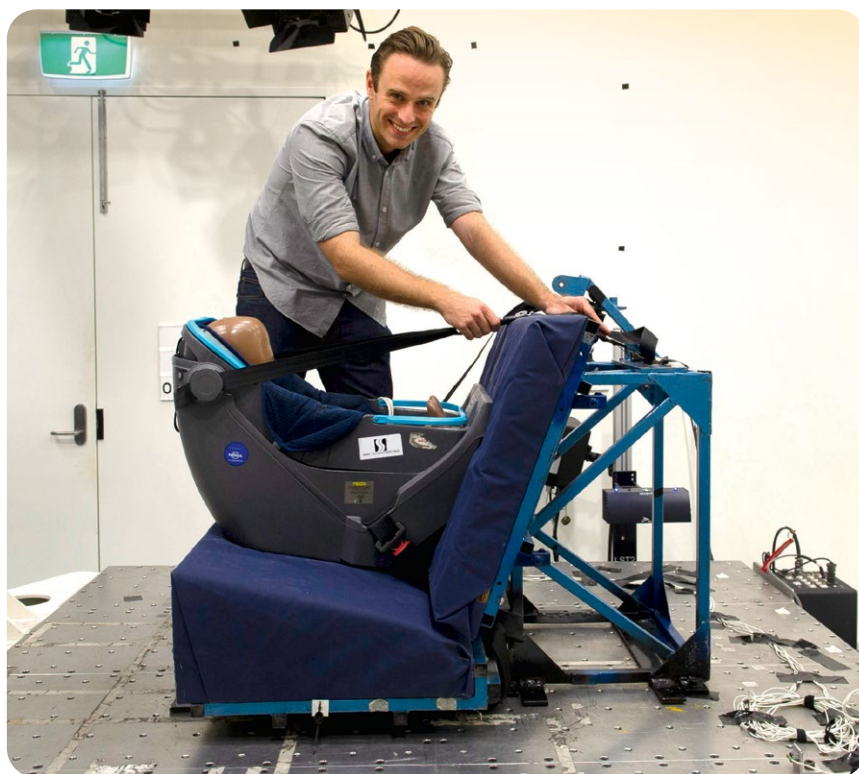
“If you’re unsure about the protection offered by an older child restraint, we recommend using restraint fitting stations that can conduct the necessary



Some of the older child safety seats used by researchers to conduct this study

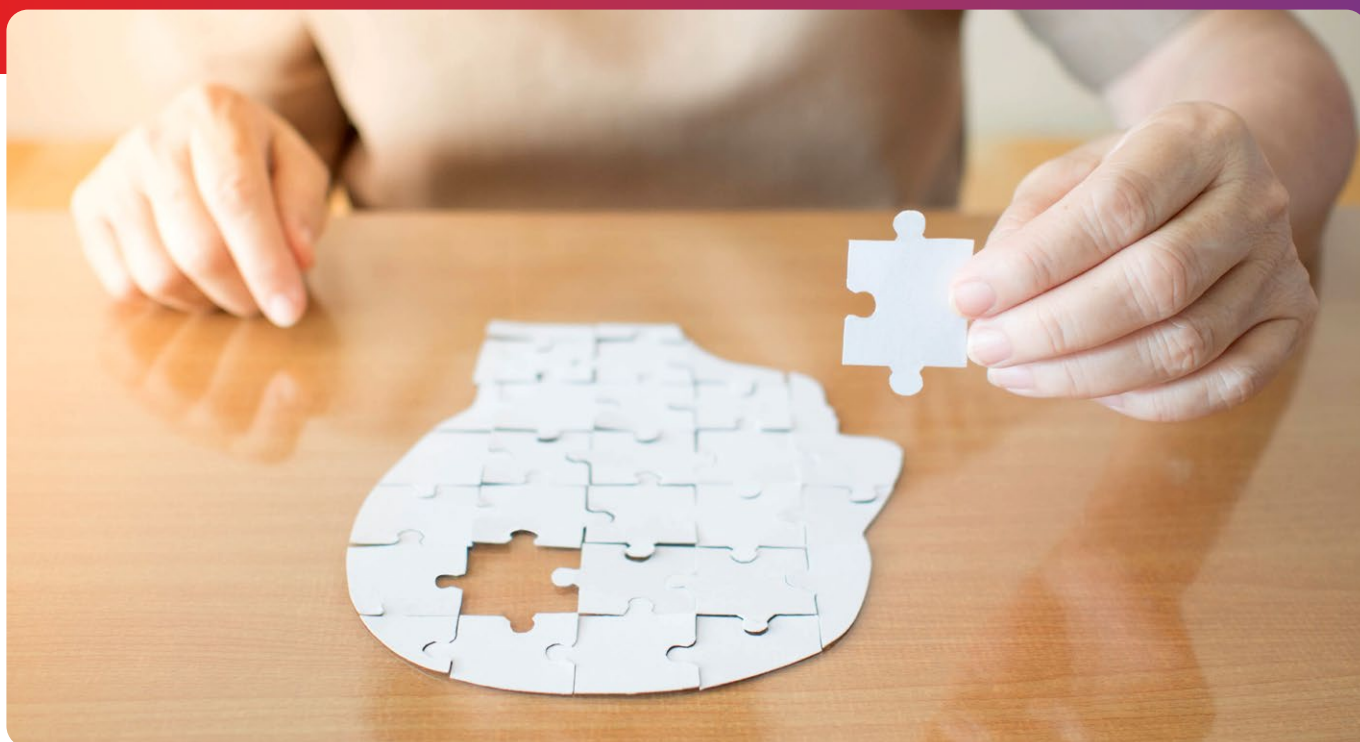
inspections to determine whether the restraint is safe to use,” he said.

For more information about installing restraints, parents can access the NSW Government’s *Restraint Fitters Manual*, which was designed following consultations with NeuRA researchers.



Dr Tom Whyte fitting a child safety seat to the sled for a crash test

# MENTAL ILLNESS



## HEALTH CHALLENGE

Mental illness places a major burden on communities across Australia, with one in five people experiencing one or multiple mental health disorders each year.

Mental illness does not always occur on its own, and is often a symptom of, or exacerbated by, other illnesses caused by infection, metabolic diseases or even cancer. In fact, up to 70 per cent of cancer patients and survivors report symptoms of depression and anxiety, and there is currently no cure for cancer-associated psychiatric symptoms.

Two of the most severe forms of mental illness are schizophrenia and bipolar disorder, each of which affects approximately one in a hundred Australians. These disorders are often characterised by distressing hallucinations and delusions, premature cognitive decline and life-impairing social withdrawal, which leaves 80 per cent of people with schizophrenia unemployed. In addition to this, the medicines used to treat schizophrenia and bipolar disorder are only partially effective, meaning one-third of those treated are unresponsive to medication.



## NEURA'S ACTION

Our researchers are investigating the processes by which mental illnesses develop and how treatment and prevention methods can be improved. This includes Australia's largest-ever longitudinal mental health and wellbeing study on twins, which is looking into the way that genetics and environment interact to cause mental illness.

We are also dedicated to understanding how inflammation in the body can hijack the brain to influence symptoms of depression, anxiety and memory impairment, so that targeted personalised treatments can be developed.

Since the 2015 merger between NeuRA and the Schizophrenia Research Institute, NeuRA has been comparing the brains of those affected by schizophrenia with those from the general population to determine the underlying molecular and cellular causes of schizophrenia. This work has led to the repurposing of already available drugs so that symptoms and cognitive function can be improved.

## POTENTIAL IMPACTS IN AUSTRALIA

NeuRA’s research is helping Australia address rising mental health issues within the population. Our projects cover all age groups and span an array of mental disorders, with active programs in anxiety, depression, chemobrain, schizophrenia, bipolar disorder, and autism.

Our mental health research:

- Gives us a better understanding about the way that genes and environment interact to shape mental illness, which can help us to reduce the risk and impact of these conditions.
- Informs and improves the techniques and medications used to treat disorders, such as anxiety, bipolar disorder or schizophrenia. This includes testing certain antibodies that could improve schizophrenia symptoms.
- Shows how social media platforms can be used to benefit, rather than compromise, the mental health of teenagers.
- Helps medical practitioners to better identify the signs that someone is more likely to develop a mental disorder, including internal inflammation, and therefore take pre-emptive steps, such as blood tests and medications, to address this.



In Australia, mental illness accounts for **12%** of the total burden of disease and **23%** of non-fatal burden of disease



Over **13%** of children and young people aged 4 to 17 years, and approximately **45%** of the adult population meet criteria for a mental disorder in any given year.



## SNAPSHOT OF CURRENT RESEARCH

**The connection between genes and wellbeing:** studying hundreds of twins to examine the genetic, environmental and biological factors that contribute to wellbeing and the ability to cope in the face of adversity.

**Schizophrenia and inflammatory brain invaders:** we have discovered that the brain of about half of those with schizophrenia is inflamed. In patients with active inflammation, we find more invading immune cells which opens up new avenues for clinical trials and potential treatment options.

**NSW Child Development Study:** identifies the earliest risk factors for mental disorders to inform preventative interventions at a population level, using linked administrative data from birth to adolescence for over 91,000 children.

**Genetic contributors, clinical course and pharmacogenomics of bipolar disorder:** using electronic health records to discover genomic signatures that increase risk of bipolar disorder and resistance to treatment, and to identify other factors that influence poor physical health outcomes for people with bipolar disorder to improve quality of life.

**The impact of cancer and cancer treatment on long-term brain health:** investigating the impact of cancer and cancer treatment on the development of learning, memory, concentration and stress disorders, to uncover the biological causes of cancer-associated cognitive impairment and identify novel treatments of “chemobrain”.



## RESEARCHERS ARE INVESTIGATING THE IMPACT OF INSTAGRAM ON TEEN MENTAL HEALTH

NeuRA has begun a new ground-breaking study to better understand the mental health impact of social media on teenagers.



The study is led by our mental health expert, Dr Justine Gatt. She is examining the positive and negative impact of Instagram on teenagers from 13 years old.

Dr Gatt's study will analyse how 2500 teenagers in Australia and the United States are using Instagram over a six-month period. Her goal is to understand how teenagers behave on the platform, and how this correlates with their mental health.

"Adolescence is a critical period where the brain develops rapidly and young people learn how to respond to their environment," said Dr Gatt.

"Social media can have a positive influence on teenagers as it connects them with peers and creates a sense of community. But it can also lead to unhealthy behaviour, such as creating negative perceptions of one's body image or cyberbullying," she said.

Teenagers spend at least 1200 hours a year on social media, which makes it highly likely that these platforms are having an impact on their development.

Instagram is now the most popular social media platform among younger Australians, and Dr Gatt's results will lead to recommendations about the healthy use of Instagram for this age group.

"Over the past decade, there's been a dramatic shift in how we use social media platforms," said Dr Gatt.

"To create the best health guidance for younger Australians, it is essential we study users today to learn about how their mental health is being impacted by rapidly changing technologies," she said.

***Social media can have a positive influence on teenagers ... But it can also lead to unhealthy behaviour, such as creating negative perceptions of one's body image or cyberbullying***

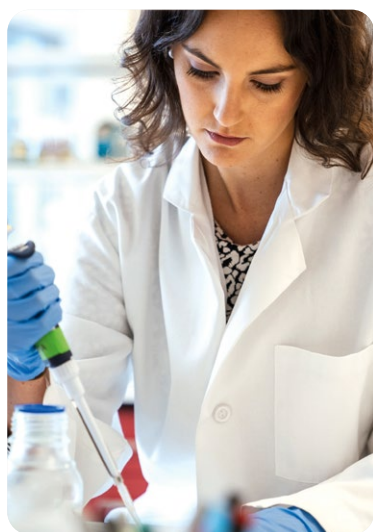
DR JUSTINE GATT, MENTAL HEALTH EXPERT AT NEURA

## TEAM DISCOVERS A LACK OF NEW BRAIN CELLS IN PEOPLE WITH SCHIZOPHRENIA

NeuRA’s Professor Cyndi Shannon Weickert and her team are exploring the underlying factors and potential causes that could lead to schizophrenia.



NeuRA PhD student, Christin Weissleder



NeuRA PhD student, Hayley North

Their work to improve our understanding of schizophrenia could lead to more effective treatment methods, and potentially improve our understanding of how to prevent this terrible illness.

One of the team’s newest studies has been to investigate the abnormal changes in brain development that seem to cause schizophrenia symptoms.

Professor Shannon Weickert’s team has discovered that people with schizophrenia have compromised *neurogenesis*. Simply put, this means that people with schizophrenia do not have the same ability to create new brain cells as other people.

“Without the ability to develop new cells, the plasticity of the brain is compromised. As a result, the brain is less able to change and rewire, making learning, memory and emotional regulation very difficult,” said Professor Shannon Weickert.

This discovery could lead to new thinking about the physical changes in the brain of someone who has schizophrenia, and what medical practitioners could do to address this.

“The likelihood of these individuals developing cognitive deficits and, unsurprisingly, mental health disorders, is high,” said Professor Shannon Weickert.

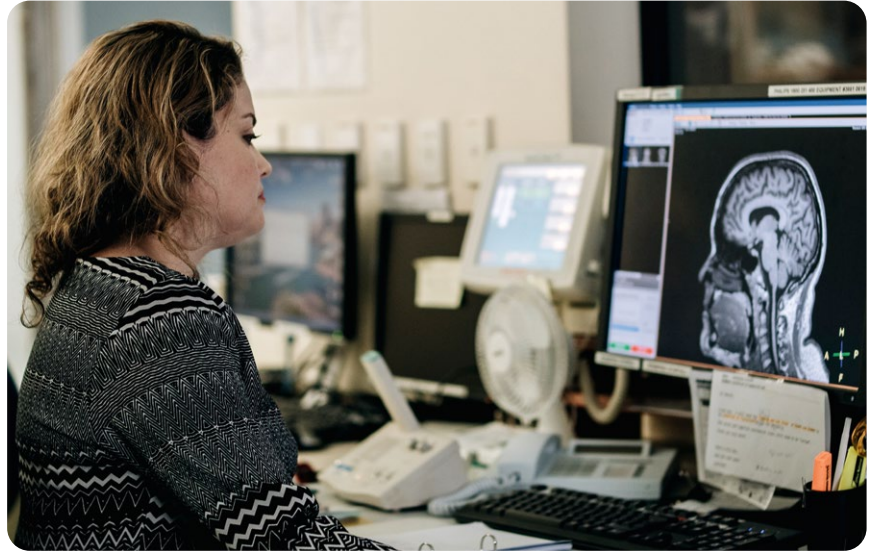
“While our cognitive performance declines as we get older, the implication for people with schizophrenia is that their brain ages at an accelerated rate. This can leave a person with schizophrenia who is in their thirties with a brain that functions like someone up to two decades older,” she said.

The research team is now exploring how to put this new knowledge to best use to help those living with schizophrenia.



## FINDING THE KEY TO MENTAL RESILIENCE

Dr Justine Gatt is studying hundreds of twins to identify whether resilience against mental health disorders is primarily determined by our genes or our environment.



Dr Justine Gatt examining the structural changes in the brain

“No one knows whether people have certain genes that make them intrinsically more resilient to mental illness over time, or whether it is someone’s life experiences that helps protect them from disorders such as depression or anxiety disorder,” said Dr Gatt.

The study of 260 identical and non-identical twins involves comparing and contrasting their mental wellbeing and brain structure and function over a 10-year period.

“Given the known genetic differences between identical twins and non-identical twins, we are able to use this information to model how changes in mental wellbeing and changes in the brain are determined by genetic factors or their environments – or both,” said Dr Gatt.

“This will help us understand the underlying mechanisms that impact our mental state and how we can maintain optimal mental health despite the stressors we can all experience,” she said.

The same 260 twins were also part of a larger mental health study that took place 10 years ago with 1400 other twins. This study found that both genes and environment impact a person’s mental wellbeing, but researchers are yet to determine how this changes over long periods of time.

“We are analysing their mental wellbeing over the past decade to identify which key factors are predicting the twins’ resilience or susceptibility to mental illness,” said Dr Gatt.

The findings of this study could allow clinicians to create more effective and individualised approaches to prevent and treat debilitating mental illnesses.



Research participants and identical twins, Amy and Rachel Maitland



# UNDERSTANDING PAIN



## HEALTH CHALLENGE

Pain that lasts for over three months is defined as chronic, and it is Australia's third most costly health burden.

Unlike temporary pain, which disappears once its source has healed, chronic pain lingers and disrupts someone's ability to exercise, perform domestic chores, socialise and remain independent.

Chronic pain has a huge impact on the nation, with one in five Australians, living with the condition. It can lead to disability and a significantly reduced quality of life.



## NEURA'S ACTION

The main initiative of NeuRA's Centre for Pain IMPACT is to investigate mechanisms of pain to advance clinical translation.

Our research investigates the causes of chronic pain, and the role of the brain in shaping our experience of pain. Scientists are able to use this knowledge to develop new more effective treatments that target an array of pain conditions.

## POTENTIAL IMPACTS IN AUSTRALIA

NeuRA researchers have conducted projects into a range of pain conditions, such as low back pain, spinal cord injury neuropathic pain, orofacial pain, osteoarthritis, migraine, burning mouth syndrome, sickle cell disease and rheumatoid arthritis.

Our work has significantly improved knowledge around how the brain processes pain and related symptoms. As a result, our studies have been able to target specific sites in the brain to improve the effectiveness and timing of interventions and treatment for pain-related conditions.

Our pain research has:

- Tested the clinical effects of popular pain treatments, including heavily used drugs, such as opioids and paracetamol.
- Identified why people with chronic pain feel pessimism, fear and anger, and what needs to be done for this to change.
- Increased the public knowledge around low back pain via social media, including self-management techniques.
- Identified early recovery and intervention options for low back pain, which affects about 16 per cent of the population

***Our work has significantly improved knowledge around how the brain processes pain and related symptoms.***

Currently in Australia



people experience chronic pain and chronic pain costs **\$73.2 billion** per year

A total of

**5.23 million**

Australians will be living with chronic pain by



**20%** of all GP presentations in Australia involve chronic pain, and **medication is used in 70%** of these consults



**Chronic pain**

is Australia's third leading cause of total disease burden



## SNAPSHOT OF CURRENT RESEARCH

**The STOPain Trial:** tests a non-invasive therapy that teaches patients to have direct control over their brain activity via EEG neurofeedback in a way that reduces their pain. The pilot studies are highly promising and we are now ready to comprehensively test this new therapy in a randomised controlled trial.

**MEMOIR - a clinical trial for Complex Regional Pain Syndrome (CPRS):** investigates the effectiveness of two unique brain-directed treatments to reduce pain for the 20,000 Australians with CPRS.

**PREDICT - a novel cortical biomarker signature for predicting pain sensitivity:** examines whether people at risk of developing chronic pain can be identified using EEG and non-invasive brain stimulation.

## DISCOVERY INTO HOW CHRONIC PAIN ALTERS PERSONALITY

NeuRA's pain expert, Associate Professor Sylvia Gustin, has made a new discovery about the relationship between chronic pain and negative emotions.



Associate Professor Sylvia Gustin talking to Daune Coogan

She discovered people with chronic pain lack the brain's key chemical messenger, glutamate, which is normally responsible for regulating thoughts and emotions.

The implications of Associate Professor Gustin's discovery are significant, and could potentially explain why almost half of people with chronic pain experience mental health conditions, such as depression and anxiety.

"Understanding this link is important for people with chronic pain, as they are often unfairly labelled as having certain personality traits that make them more likely to experience pain. What we discovered proved this is not the case," explained Associate Professor Gustin.

An example of this link was discovered in Associate Professor Gustin's research participant, Daune Coogan who experiences a painful condition called Ramsay Hunt syndrome.

"The pain was completely debilitating, as if someone had put a hot poker in my ear canal and across my face. It was so extreme that I basically collapsed and was rushed to hospital," said Ms Coogan.

She volunteered in Associate Professor Gustin's study in the hope that she'd learn more about her chronic pain and how it was affecting her.

"People like Daune have decreased glutamate levels in their brains, which could very well be having a significant impact on their personalities over time," said Associate Professor Gustin.

"So the next part of my research is to test whether increasing glutamate levels will actually reverse negative personality changes that are being caused by chronic pain and the disruptions in our brain," she said.

**Associate Professor Gustin discovered people with chronic pain lack the brain's key chemical messenger, glutamate, which is normally responsible for regulating thoughts and emotions**



## SELF-MANAGEMENT SOLUTIONS TO LOWER BACK PAIN

NeuRA researchers are embarking on a new study to help people recover from chronic low back pain.



About 20 per cent of Australians currently experience back pain, with about one third developing chronic low back pain, where the pain extends beyond 12 weeks and sometimes lasts for years. This is a massive health burden on the nation, with Australians spending a staggering \$8 billion to treat back pain each year.

Australians commonly respond to this pain by seeking medical treatment. But NeuRA researchers and international experts say the most effective method of recovery is self-management, which is the focus of the new study led by Associate Professor James McAuley.

As head of NeuRA's Centre for Pain IMPACT, Associate Professor McAuley's goal is to debunk the popular belief that professional help is the best method of treatment to low back pain.

His team is rolling out a project that uses social media to deliver information to the public about how to most effectively recover from this type of pain.

The team will examine contemporary discourse on social media posts to better understand conversations around low back pain. They will also review public attitudes toward the expert recommendations people commonly receive while seeking treatment.

"It's important we understand whether people are more inclined to follow or ignore recommended methods of recovery. This is why it is vital that we investigate people's reactions to the self-management health advice that they receive," said NeuRA researcher, Edel O'Hagan, who is conducting the study.

The next stage of this research involves developing targeted messaging that provides the best possible advice about how people with low back pain can self-manage their treatment. This messaging will involve advice from a wide array of health professionals, such as physiotherapists, psychologists, orthopaedic surgeons and rheumatologists.

This project will deliver personalised, relevant care for people with low back pain to improve their quality of life. The findings could also help clinicians to deliver education-based interventions that are quick, effective and cost-efficient.

## PROVING PAIN SENSITIVITY CAN BE PREDICTED

Pain is an incredibly subjective condition in that we each have differing levels of pain tolerance. As a result, some people are more inclined to feel and report pain than others.

Chronic pain, where the hurt lingers, is loathed not only by those that experience it but also by clinicians, who are often left feeling unable to heal their patients.

To reduce the likelihood of this predicament, NeuRA researchers are embarking on a project to see if people who are at risk of developing chronic pain can be identified before their pain becomes long-term.

Associate Professors David Seminowicz and Siobhan Schabrun and their teams are examining whether a certain biological marker in the brain, which indicates high pain sensitivity, can be used to predict the development of chronic pain symptoms.

“The biomarker we are working on can determine pain sensitivity before a person actually experiences pain or during its very early stages,” said Associate Professor Seminowicz.

Participants in the study will experience a long-lasting jaw muscle pain, which mimics some of the symptoms of painful temporomandibular disorders. During this two-week period,

researchers will measure participants’ brain activity and jaw muscle response to using electroencephalogram and brain stimulation. Participants will also be asked to keep a daily pain diary.

“We are using brain mapping techniques to attempt to predict which participants will have the most and longest lasting pain,” said Associate Professor Seminowicz.

The study will help researchers in two ways. First, the findings will help explain why some people are more sensitive to pain, and second, it will confirm whether this biomarker can predict who is at high chronic pain risk.

“By finding early biomarkers of pain severity, we have an opportunity to help people avoid developing debilitating persistent pain by treating the pain earlier on,” said Associate Professor Seminowicz.

If the biomarker is found to be a successful predictor of pain sensitivity, this study will inform the development of new and effective treatment approaches to chronic pain.





# SPINAL CORD INJURY



## HEALTH CHALLENGE

Spinal cord injury occurs when trauma or disease damages the spinal cord and prevents the normal communication from the brain to the body and from the body back to the brain.

The condition can lead to loss of strength, loss of sensation, increased spasticity, and impairment of other functions. With a reduced ability to contract the diaphragm and abdominal muscles to breathe and cough, people with this injury are also at risk of pneumonia and other respiratory infections.

As a major cause of physical disability, people with spinal cord injury often face challenges when trying to complete even most basic of tasks during their day to day activities, including bladder and bowel control, sexual function, and maintenance of blood pressure. Spinal cord injury significantly decreases quality of life and places a huge burden on health care providers.



## NEURA'S ACTION

NeuRA has long been a leader of spinal cord injury research in Australia. In 2020, NeuRA opened its new Spinal Cord Injury Research Centre. The Centre conducts research aimed at improving the lives of those with spinal cord injuries.



## POTENTIAL IMPACTS IN AUSTRALIA

NeuRA's Spinal Cord Injury Research Centre contains state-of-the-art exercise, rehabilitation and neurophysiology equipment. The Centre will provide a focus within the institute for spinal cord research.

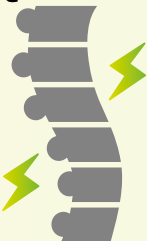
Specifically, it will:

- Use novel therapies to restore the function of limb and breathing muscles after spinal cord injury.

- Incorporate new technologies, such as virtual reality to help restore feeling and movement to limbs.
- Test whether neurostimulation can help people with paralysis to walk again.
- Help people with impaired breathing function due to diaphragm and abdominal weakness to strengthen their muscles and breathe more easily.

*Test whether neurostimulation can help people with paralysis to walk again.*

Over **12,000** Australians are paralysed by spinal cord injury, with **a new case occurring every day**



Each injury has an average lifetime cost of care of over

**\$5 million** per person




Spinal cord injury is estimated to cost the Australian economy over **\$2.5 billion** per annum



People with a spinal cord injury are over

**150 times** more likely to die from pneumonia than the general population




## SNAPSHOT OF CURRENT RESEARCH

**Therapeutic acute intermittent hypoxia to restore voluntary function:** aims to assess the effectiveness of sessions of therapeutic acute intermittent hypoxia (reduced oxygen) in improving both breathing and the control of muscles after a spinal cord injury through neuroplasticity.

**Virtual reality treatment to restore touch and feeling:** develop and test the world's first immersive virtual reality interface that simultaneously enhances surviving spinal nerve fibres and touch signals in the brain in an effort to help people regain a sense of touch and feeling throughout their body.

**Neurostimulation to aid walking:** assess in a formal randomised controlled trial the ability of a form of spinal cord stimulation to improve the capacity of people with paraplegia to walk. This treatment will be combined with state-of-the-art treadmill and standing training.

**Abdominal Functional Electrical Stimulation:** undertake world first randomised controlled trials to ascertain whether applying small electrical pulses to strengthen the abdominal muscles can: reduce respiratory complications, reduce the time spent breathing with the assistance of a mechanical ventilator, and improve the bowel function of people living with a spinal cord injury.

## SPINAL CORD INJURY RESEARCH CENTRE OFFERS NEW HOPE

In July 2020, NeuRA opened its new Spinal Cord Research Injury Centre, which will become one of Australia's leading centres exploring a cure for paraplegia and quadriplegia.



Researchers in the Spinal Cord Injury Research Centre. From left: SpinalCure CEO Duncan Wallace, NSW Health Minister Brad Hazzard, NeuRA CEO Peter Schofield, NSW Treasurer Dominic Perrottet, NeuRA Deputy Director Simon Gandevia

It was opened by New South Wales Minister for Health and Medical Research, Brad Hazzard, and the Treasurer, Dominic Perrottet, who also announced \$6.4 million in funding for NeuRA's spinal cord injury research projects.

The Centre, partly funded by SpinalCure Australia, will be home to new cutting-edge technology which will facilitate research that aims to improve health outcomes for people with spinal cord injuries.

"These projects have great scope, from investigating ways to restore touch sensation through immersive virtual reality through to using electrical stimulation to improve breathing for people affected by the most severe form of paralysis," said Minister Hazzard.

NeuRA's CEO, Professor Peter Schofield AO, thanked both the NSW Government and SpinalCure Australia for their contribution to spinal cord injury research.

"This contribution will help NeuRA to make new research breakthroughs by using cutting edge technology to improve our understanding of how we can best treat people with spinal cord injuries," he said.

The Ministers were shown a demonstration of one of NeuRA's new research projects. This project, led by Senior Research Scientist Dr Euan McCaughey, involves using electrical stimulation to move parts of the body that are otherwise paralysed.

"This program of work greatly expands our previous research and could significantly improve the lives of those living with a spinal cord injury," said Dr McCaughey.

One of NeuRA's research participants, Steve Ralph, assisted by demonstrating the effect of functional electrical stimulation. The Ministers, guests and journalists let out a murmur of excitement as Dr McCaughey demonstrated how electrical stimulation could bring movement back to Steve's hand.

"These researchers are so committed to improving the living conditions of people who have a spinal cord injury. Their passion and enthusiasm gives me hope that some kind of cure might be found one day," said Mr Ralph.

## FORGING NEW PARTNERSHIPS TO ADVANCE SPINAL CORD INJURY RESEARCH

The building of our new Spinal Cord Injury Research Centre has enabled NeuRA to embark on exciting new partnerships as part of our mission to increase the scope and speed of our findings.

In 2019, NeuRA announced a new collaboration with SpinalCure Australia, an advocacy organisation committed to generating funding and support for spinal cord injury research. SpinalCure Australia contributed significant funding to help build the Centre.

“SpinalCure has been campaigning to bring neurostimulation research to Australia for several years and we are delighted to be working with NeuRA, which has one of the world’s most respected movement and spinal injury teams,” said SpinalCure CEO, Duncan Wallace.

SpinalCure’s ambassador Sam Bloom, a leading advocate and the inspiration behind the Hollywood film, *Penguin Bloom*, is working with NeuRA’s researchers. She’s expressed enthusiasm and hope about the new Centre’s capabilities.

“I’m so excited to be connected to the researchers at NeuRA, and to be part of the inspiring projects they are undertaking at the new Centre. Their devotion to finding a way to repair spinal injury gives inspiration to people with paralysis in Australia and across the world,” Ms Sam Bloom said.



MRI is used to diagnose spinal cord injuries, including vertebral problems and fractures



L to R: Michael Rabbitt (SCIA Chair), Peter Schofield AO (NeuRA CEO), Tommy Little, Simon Gandevia (NeuRA Deputy Director), Dianne Lucas (SCIA CEO)

**In 2019, NeuRA received a generous donation from Spinal Cord Injuries Australia (SCIA), an organisation that serves 2,500 people that are affected by spinal cord injury.**

New Zealand’s CatWalk Spinal Cord Injury Research Trust have also partnered with NeuRA, contributing AU\$600,000 to a major three-year research project into reactivating otherwise paralysed muscles.

In 2019, NeuRA received a generous donation from Spinal Cord Injuries Australia (SCIA), an organisation that serves 2,500 people that are affected by spinal cord injury.

SCIA’s ambassador and well-known Australian comedian, Tommy Little, participated in the *Antarctic Ice Marathon* and raised over \$115,000

for work led by NeuRA’s Senior Principal Research Scientists, Professors Simon Gandevia and Jane Butler.

“The support of partners such as SpinalCure Australia, CatWalk and SCIA, has enabled NeuRA to dramatically advance our spinal cord injury research capabilities and hopefully accelerate the ability for people with this condition to walk and use their hands again,” said Professor Gandevia.



## LANDMARK PROJECT BEGINS TO HELP PEOPLE WITH PARALYSIS

Approximately 6000 people are living with a condition called tetraplegia, where all four of their limbs are paralysed. It often results in an inability to control the abdominal muscles, and therefore a decreased ability to breathe and cough, which can lead to respiratory complications.



Dr Euan McCaughey demonstrating his electrical stimulation research

Because of this, people with tetraplegia often require a mechanical ventilator to help them breathe. They also struggle with simple bodily activities that are often taken for granted, such as bowel control.

However, NeuRA is embarking on a new project that could drastically improve the quality of life for people with a spinal cord injury.

Senior researcher Dr Euan McCaughey has obtained funding from the NSW Government for a landmark study that could reduce the number of respiratory problems people with a spinal cord injury have. This study could also reduce the length of time people with tetraplegia

would require a mechanical ventilator and improve their bowel function.

Ventilators are commonly used in hospitals to treat people who have developed pneumonia, a disease which can have particularly tragic outcomes for people with spinal cord injury.

“This group are 150 times more likely to die from pneumonia than the general public,” said Dr McCaughey.

Dr McCaughey’s study is backed by previous research that shows patients could reduce their chances of getting respiratory problems and their dependence on these ventilators.

“We’ve had demonstrated success that this treatment is effective in

other conditions where mechanical ventilation is required. We are now embarking on a full clinical trial to evaluate whether this technique works for people with tetraplegia,” said Dr McCaughey.

Treatment via the electrical stimulation is simple. A small electrical current is applied to the abdominal muscles for 45 minutes per day via electrodes placed on the torso. The electrical stimulator is cost-effective and easy for hospitals to obtain.

“This program of work will greatly expand previous research and significantly improve the lives of those living with a spinal cord injury,” said Dr McCaughey.

# EXPLORING THE BRAIN



## HEALTH CHALLENGE

One in six Australians are affected by brain disease at some point in their life. These conditions, such as Alzheimer's and Parkinson's diseases, limit the ability to move, speak and think coherently. They also typically become progressively worse and cause death.

Certain genes are known to mutate and cause these diseases, as well as intellectual disability, but the contributing factors for most brain conditions largely remain unknown.

There is a great need to understand how brain structure and neural activity is linked to cognitive function and behaviour. This is particularly important when looking at neurodegenerative diseases that cause a disruption in someone's movement and mental function.



## NEURA'S ACTION

NeuRA's research involves examining brain structure and function in people of all ages. Mapping the human brain enables scientists and medical practitioners to observe changes in brain structure as people age or experience disease. We have developed two brain atlases that helps researchers look into brain regions and monitor their function.

Brain activity is assessed using our recently opened NeuRA Imaging facility, which features the latest in MRI scanning technology. This Centre is being used to examine the brains of NeuRA's research participants during their lifetime.

We also conduct neurogenomic research to understand how genes in young people affect the development of the nervous system. This is made possible by the Sydney Brain Bank, which collects and preserves brain tissue after people pass away. Qualified researchers from NeuRA and around the world use this tissue to analyse and identify biomarkers and risk genes for neurological diseases, such as dementia.

## POTENTIAL IMPACTS IN AUSTRALIA

NeuRA's brain mapping activities, led by Professor George Paxinos AO, is among the most cited literature in neuroscience studies around the world. Similarly, the activity by the Sydney Brain Bank supports a wide array of research in Australia and abroad. Post-mortem analysis on donors with Parkinson's disease, Alzheimer's disease and even former professional rugby league players is paired with a donor's health records. This helps researchers to better understand how to prevent or treat brain-related disorders.

In 2019, the NeuRA Imaging Centre was upgraded thanks to the purchase of new Philips Ingenia CX 3T MRI scanner. This start-of-the-art scanner will enable our researchers to embark on new projects that could provide the evidence used to underpin health policy in the future.

Our activities on defects and malformation caused by human genes is helping scientists to develop effective supportive measures and medicines for intellectual disability and neural disorders.

**NeuRA's brain mapping activities, led by Professor George Paxinos AO, is among the most cited literature in neuroscience studies around the world**

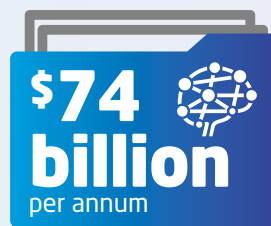
The Sydney Brain Bank, located at NeuRA, holds more than **650 brains** and has facilitated more than **300 studies since 2009**



NeuRA Imaging is a node of the National Imaging Facility. It has been a key facility in more than **\$60 million worth of grants for researchers** from nine different countries, 15 different Australian universities, eight hospitals and eight research institutes



Brain disorders cost Australia over **\$74 billion per annum** and will soon represent a greater cost to the economy than heart disease, cancer, and respiratory disease combined



## SNAPSHOT OF CURRENT RESEARCH

### Donor program with National Rugby League players:

examining the brain tissue of individuals who have experienced repeated repetitive traumatic brain injury to determine how this impacts brain health.

### Caress the Detail: A Comprehensive MRI Atlas of the Human Brain:

This project aims to deliver the most comprehensive, detailed and accurate MRI atlas of the human brain.

### Understanding new forms of dementia in the elderly:

will determine the prevalence of a seemingly new form of dementia, abbreviated to LATE, in the Sydney Brain Bank cohort and to better understand the changes in the TDP-43 protein that accumulates in affected brain regions.

### A new paradigm for understanding brain activation:

working out where and how brain stimulation methods activate the brain and how better to target them to improve brain function and mental health.

### PreGen: Filling the Gap - Antenatal Genomics and Newborn Care:

explores whether neurological conditions present before birth and whether earlier forms of treatment may be available.



## NEURA RESEARCH SUPPORTS BRAIN HEALTH OF NRL PLAYERS

The Sydney Brain Bank at NeuRA has recently formed a collaboration with a new brain donor program to support athletes involved in contact sports.



We have partnered with National Rugby League and Newcastle University to examine the brain health of retired, top grade players and look into the consequences of head injuries.

Dr Claire Shepherd, the Director of the Sydney Brain Bank, is leading a research team to examine whether impacts to the head might be causing cellular changes to the brains of these players, which is often referred to as chronic traumatic encephalopathy (CTE).

The Sydney Brain Bank will collect the brains of former players who have signed up to our research project, in the hope that this work can lead to better health recommendations for NRL players.

Before donating their brain, players will be assessed by researchers at Newcastle University who will look at whether they are experiencing neurological changes, such as forgetfulness.

“This is the first program in Australia to study the impact of sports injuries on the brains of former NRL players who have been monitored in the clinic for years before their death,” said Dr Shepherd.

“This is a complex research area that will require long-term commitment and funding. The findings from this new donor program will help us answer key questions about sports-related brain injuries,” she said.

***This is the first program in Australia to study the impact of sports injuries on the brains of former NRL players who have been monitored in the clinic for years before their death***

DR CLAIRE SHEPHERD,  
THE DIRECTOR OF THE  
SYDNEY BRAIN BANK

## THE MACHINE FOR EXPLORING INNER SPACE

In 2019, NeuRA built a new state-of-the-art Imaging Centre with magnetic resonance imaging (MRI) technology that will facilitate hundreds of promising research projects.

**MRI** uses a powerful magnet and radio waves to produce three-dimensional imaging of the body, including detailed anatomy of the brain. It can also provide information about how the brain functions and can look at the chemical makeup of specific areas.

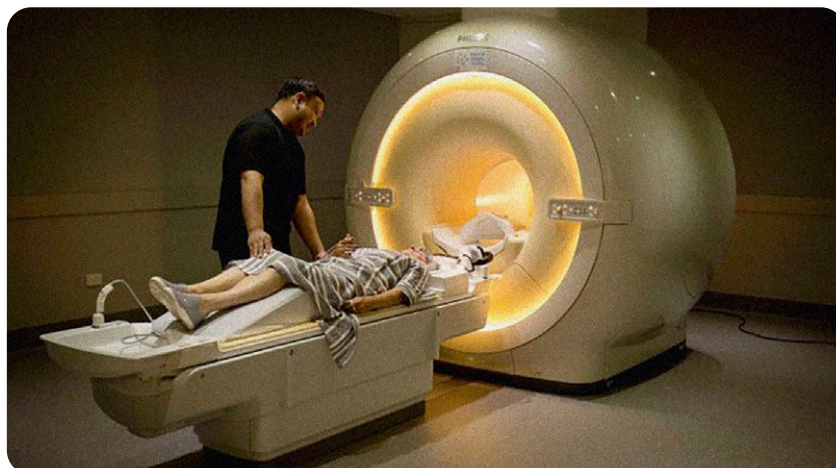
This non-invasive technology avoids potentially dangerous radiation used in other medical imaging methods. It is used by neuroscientists and medical practitioners to identify where in the brain disease is located, so that affected regions can be diagnosed with the goal of treatment or management.

NeuRA's new scanner enables researchers to undertake projects that have significant potential to help communities. This includes providing evidence to underpin health policy on the safety and efficacy of treatments, discovering the underlying changes that lead to disease and neurodegeneration, as well as fascinating discoveries about how the brain actually works.

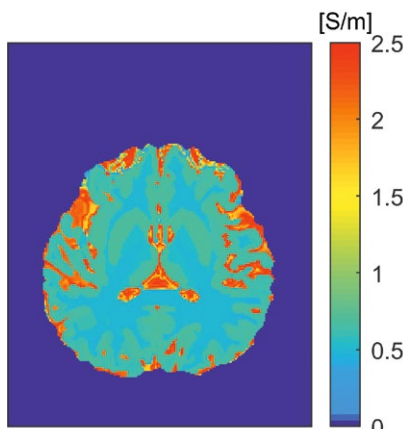
The head of the NeuRA Imaging Centre, Professor Lindy Rae, is embarking on a study to examine how stimulation therapies help treat depression and how to improve these therapies to provide better patient outcomes.

"There are a range of therapies that treat depression and other disorders by stimulating the brain with electric or magnetic stimulation," said Professor Lindy Rae.

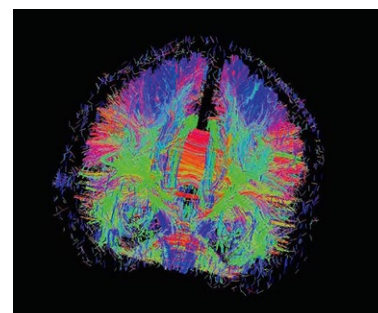
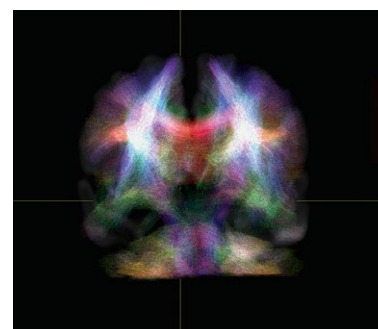
"We have developed a method using our new scanner that can map where and how this stimulation might work. This way,



Mr Ryan Castillo conducting an MRI scan with a research participant



Slice through the brain showing tissue conductivity (ability of the tissue to conduct an electric signal) using a new technique called magnetic resonance electrical properties tomography



Images show white matter (nerve connections) that are impacted by Williams Syndrome

we can better target the relevant brain regions and provide each patient with the most optimal treatment regime," she said.

The NeuRA Imaging Centre gives researchers new perspective in how they look at diseases and disorders. These new outlooks result in fresh approaches to treatment and management of health.



## RESEARCHERS CREATE COMPREHENSIVE BRAIN ATLAS

The brainstem controls the flow of information from the brain to the body and is critical for the regulation of functions such as breathing, movement, and arousal, as well as cognition and emotion.

To assess how the central trunk of the brain operates, scientists rely on a kind of map commonly known as an atlas, which reveals its anatomy and structure. As advancements in scientific knowledge continue, brain atlases require updating so that research can be done using up to date models and data.

In 2019, NeuRA researchers led by Professor George Paxinos AO launched the world's most comprehensive atlas of the human brainstem, which is akin to a Google map for the brain, titled *Human Brainstem: Cytoarchitecture, Chemoarchitecture, Myeloarchitecture*.

This atlas is vital for learnings about certain diseases that affect the brainstem, such as multiple system atrophy, autism spectrum disorders and Parkinson's disease. It can also assist with research into depression and schizophrenia as these illnesses cause physical changes to brainstem serotonin and dopamine nuclei.



Dr Steve Kassem examining the different regions of the brain

Professor Paxinos' work is used to identify and target the regions within the brainstem that are impacted by these diseases. This enables researchers to develop more targeted and efficient methods of treating or preventing these conditions.

The atlas can also be used to navigate between the brains of humans and experimental animals and construct reliable models of disease.

“By mapping the brain, we are able to identify similarities between the human and animal brain, speed up research, and improve treatments for brain disorders,” said co-author Professor George Paxinos.

NeuRA researchers and brain researchers from around the world rely on these atlases and other similar tools to conduct research into neurological conditions.



# A message from the **Neura Foundation**

This year has been a challenging one for many of us. During the 2019 summer, most of Australia was focused on raging bushfires. Now, our attention has turned to the impact of the COVID-19 pandemic on how we live our lives.

Given the current attention on health concerns, it is more important than ever before that NeuRA remains focused on our mission to better understand, prevent and cure conditions that affect our brains. Our belief is that we are all our best selves when we are free from impairment that restricts our ability to be ourselves or live an independent life. Our goal is to equip people with the best tools to help them overcome or prevent health challenges before they occur.

Depression, dementia, falls, injury – these are but a few of the diseases and ailments that our researchers are working on every day. We have made some significant research advances over the past year and these activities are only possible thanks to the financial support from members of the community, philanthropists and corporate partners. In funding NeuRA's research, their legacy will be to improve the lives of countless people around the world.

We have moved quickly during the COVID-19 pandemic to ensure you have greater access to our research findings, especially where this information relates directly to health challenges caused by the pandemic. NeuRA is now holding regular webinars and has created a new platform on its website called Researcher News, where you can read the latest from scientists on the status of their projects and how to take better care of your health.

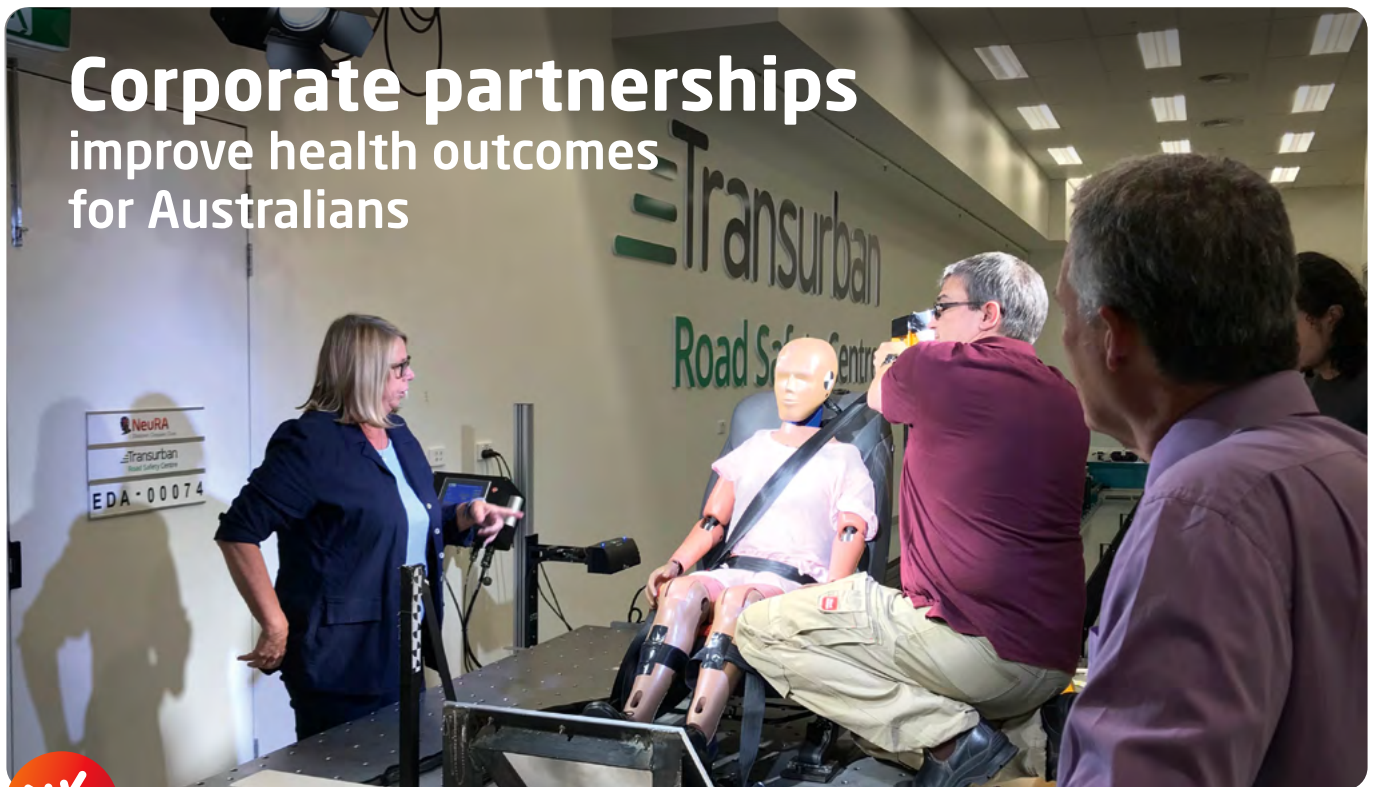
Some of our major community events were heavily impacted by COVID-19. But NeuRA has found success in the launch of its first digital fundraising event, *Colour Your Hair for Mental Health*. In October 2019, more than 2000 participants signed up to colouring their hair to support NeuRA's research.

Our Foundation is committed to providing you with the latest information about our research outcomes, and we hope you have enjoyed this snapshot into NeuRA's scientific endeavours. In spite of this year's challenges, we have been invigorated by the level of interest from our community, which has helped us to forge new partnerships and opportunities for research. This support during such trying times has emphasised how important our mission is to you. For that, we are truly grateful.



David Crisante and Stephanie Gove; NeuRA Foundation  
Acting Co-Directors

**Given the current attention on health concerns, it is more important than ever before that NeuRA remains focused on our mission to better understand, prevent and cure conditions that affect our brains**



Associate Professor Julie Brown in the Transurban Road Safety Centre

## One of the best ways for NeuRA to pursue research is through corporate partnerships with those who support our organisation's scientific endeavours.

NeuRA has partnerships with a wide array of organisations about opportunities to collaborate, including nursing homes, app developers and financial institutions.

One of our most significant partnerships is with Transurban. This collaboration began in 2017, when they provided funding to build the Transurban Road Safety Centre (TRSC) at NeuRA.

The TRSC is Australia's first research-dedicated crash test lab. It features a crash sled that enables researchers to test a variety of simulated road accidents, providing invaluable data that can be used to improve safety for road users. The Centre is staffed by a team of researchers led by NeuRA's Professor Lynne Bilston, who works closely with Transurban.

"Transurban's support has enabled our team to make some exciting discoveries that will help keep Australia's drivers, passengers and motorcyclists safer on our roads," said Professor Bilston.

"This includes improving the use and effectiveness of child restraints, providing better advice to older drivers

about how they can protect themselves while behind the wheel, and examining how motorcycles could be designed differently to reduce injury during a crash," she said.

Partnering with NeuRA offers a great benefit to our partners. Transurban's name is featured in a wide array of media reports about the Centre's findings. Additionally, NeuRA is presenting these Transurban-funded findings to Australian regulatory bodies and motorist associations to inform the development of regulations and assist road users.

In 2020, NeuRA and Transurban signed a second three-year partnership that will study:

- Motorcycle fuel tank syndrome and how to prevent pelvic injury in crashes.
- Improved dynamic testing of child restraint systems for child occupant protection.
- Designing optimised features of child restraints ensuring injury prevention.
- Protecting occupants in non-standard and future seating postures.
- Enhanced safety in the rear seat for all occupants.

Organisations interested in partnership opportunities should contact:

**NeuRA Partnership Manager Stephen Gallagher**

**E: [s.gallagher@neura.edu.au](mailto:s.gallagher@neura.edu.au)**

**P: 02 9399 1099**





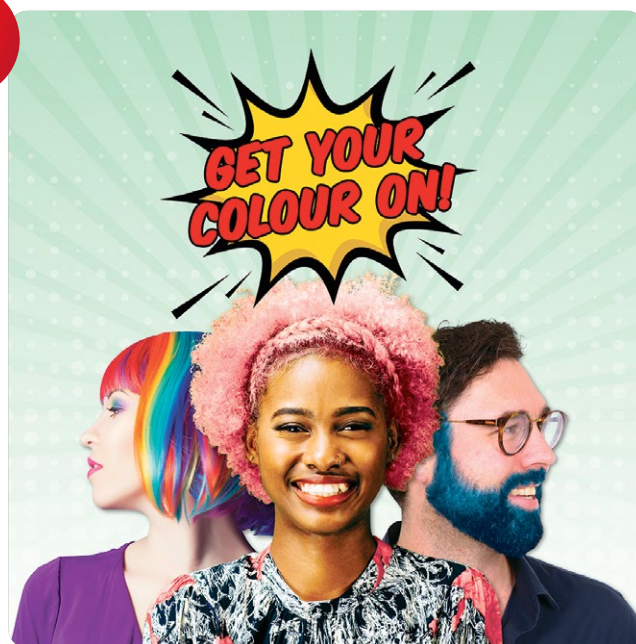
# NeuRA's colourful campaign for mental health

**In 2019, NeuRA did something new and exciting. We launched our first-ever online community event in support of our mental health research.**

Named *Colour Your Hair for Mental Health*, we reached out to Australians to ask them if they could get sponsored to dye their hair or wear a colourful wig during Mental Health Week in October.

There is often a stigma attached to mental health and many people feel that it is a taboo topic. Our campaign, with zany and colourful hairstyles, was aimed at encouraging new conversations about how we can be doing more to look after our mental health.

Our second goal was to raise much needed funds to examine how we can better prevent and treat mental illness. More than fifty per cent of Australians will experience a mental illness at some point in their lives. And with the COVID-19 pandemic, we anticipate that the need for better support and treatment will only increase.



The campaign was a resounding success. More than 2000 people participated in the campaign and raised an impressive \$125,000 to support NeuRA's mental health research. The top community fundraiser was Melbourne resident Holly Walsh, who raised more than \$5000.

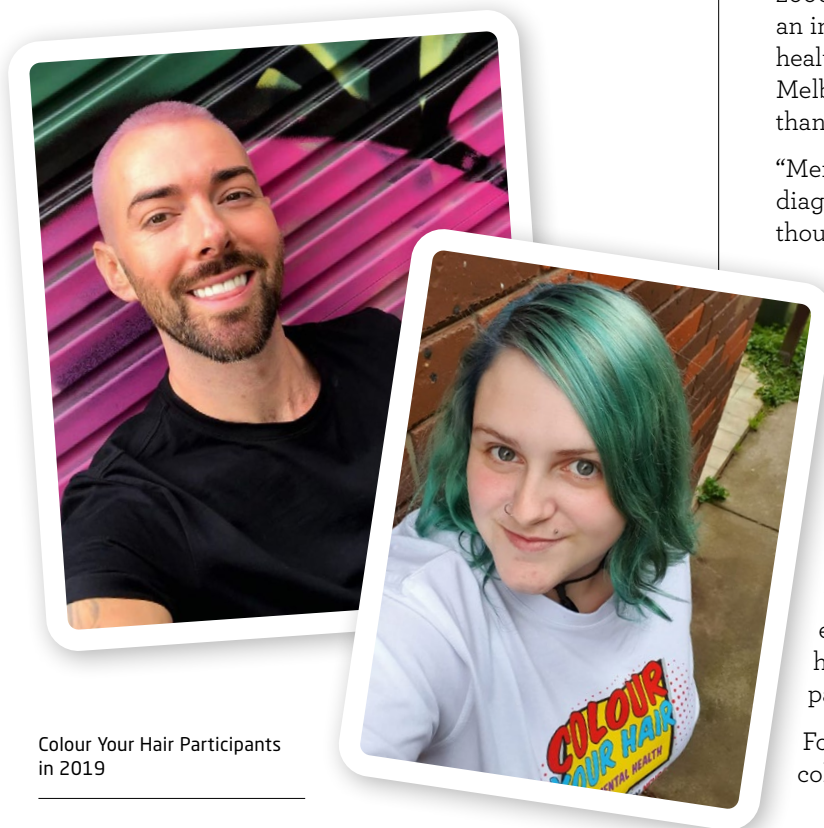
"Mental health research is important for me as I was diagnosed with an anxiety disorder when I was 21, though I had suffered with the symptoms for much longer," said Ms Walsh.

"I received an amazing amount of support from my friends and family, as well as my colleagues. When I talk to people about what I am doing a lot of people have said it's brave and have been happy to support such a great cause."

NeuRA's Partnerships Manager, Stephen Gallagher, is running our second *Colour Your Hair for Mental Health* event in October this year.

"We anticipate more sign ups and interest in the event this year. Mental health and resilience is a hot topic of conversation because of the global pandemic and social isolation measures," he said.

For more information, please visit [colouyourhair.com.au](http://colouyourhair.com.au)



Colour Your Hair Participants in 2019



## In the jungle and raising awareness for research

In 2020, Australian entertainment icon Rhonda Burchmore selected NeuRA as her charity of choice in the Network Ten series *I'm A Celebrity... Get Me Out of Here!*

The show took place in the South African jungle and was broadcast live on national television.

This meant that every vote for Rhonda resulted in a donation to NeuRA. She chose us because of our research efforts into Multiple System Atrophy (MSA), which is a rare neurodegenerative disorder that took the life of her sister. Rhonda describes MSA as the "cruellest disease" she has ever seen.

Rhonda was one of the most popular stars on the program. She overcame challenges such as eating live cockroaches, and the public voted to keep her in as one of the top three contestants.

The huge tally of votes resulted in a significant donation to NeuRA. We are incredibly grateful to Rhonda for raising awareness for motor neurone diseases and for advocating for medical research.



Viewers were encouraged to 'Vote to save Rhonda' and keep her in the running to win the competition



NeuRA team at the City2Surf race

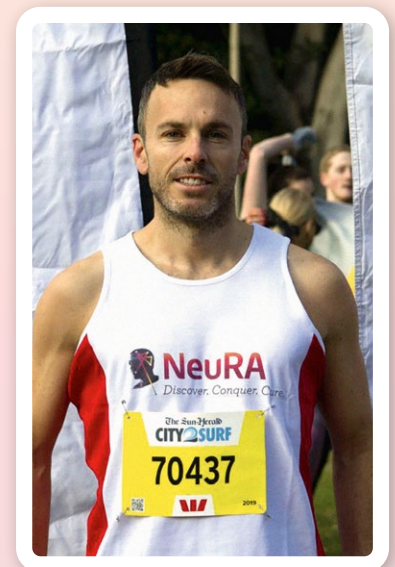
## Team NeuRA at the City2Surf

Sydney's annual Sun-Herald City2Surf, with its 80,000 runners and an abundance of friends and relatives at the ready, is one of NeuRA's key community events.

In 2019, more than 50 runners who participated in this iconic race from Sydney's CBD to Bondi Beach, managed to raise more than \$30,000 for NeuRA. This incredible effort by the team is helping NeuRA to progress research into disorders of the brain and nervous system.

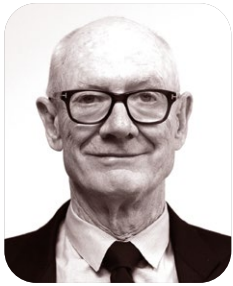
Our top fundraiser, George Hughes, raised more than \$4000 in recognition of his mother who has been diagnosed with a neurological condition known as Progressive Supranuclear Palsy (PSP).

"In time, and with the right level of funding, I am confident we'll find ways to cure diseases such as PSP. That's why we need to drive up awareness of such conditions, raise much-needed funds and support the medical and scientific community in their efforts," George said.



NeuRA's top fundraiser, George Hughes

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