NeuRA
Discover. Conquer. Cure.

Why study at NeuRA?

NeuRA's students are future research leaders. In our vibrant research environment, our students are supervised by internationally recognised experts in neuroscience.

For further information go to ***neura.edu.au/why-study-at-neura***

Honours & PhD Student Projects

September 2018

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Welcome to NeuRA

Our vision is to prevent and cure disease and disability of the brain and nervous system through leadership, excellence and innovation in neuroscience research.

About Us

NeuRA (Neuroscience Research Australia) is one of the largest independent centres of research on the brain and nervous system in Australia, based in Randwick, Sydney. Recognised as an international leader in research, NeuRA is changing the face of research into diseases and disorders of the brain and nervous system, not just in Australia, but around the world. Our eminent neuroscientists, clinicians and outstanding research leaders relate laboratory-based research to clinical research involving patients to ensure that our discoveries are translated into health benefits for people as soon as possible.

The institute hosts over 300 staff and students in ~30 neuroscience research groups spread across five broad themes. NeuRA is an independent, not-for-profit, medical research institute. It is affiliated with the University of New South Wales and South Eastern Sydney Local Health District.

Our Values

- **Ethics:** the moral principles that influence and govern our conduct
- **Enquiry:** our constant pursuit of knowledge and understanding
- **Human Impact:** our desire to make a genuine positive human health impact
- **Respect:** we respect the feelings and rights of all human beings, and admire their achievements
- **Excellence:** we will achieve the very best possible
- **Accountability:** we are accountable for our actions and decisions

Our Name

Neuroscience: the science of the brain and nervous system. It is our focus, expertise and dedication.

Research: our passion is to understand how the brain and nervous system work. Our brain controls our thoughts, feelings and mobility. It powers the electrical system that controls our heartbeat, our ability to work, breathe and swallow. But these can be stolen by disease, mental illness and injury. The solutions will only be found through medical research. Research provides the power to cure.

Australia: our position in the global research environment. Our research is for Australia because it impacts all Australians, directly and indirectly.

Our Research

The focus of NeuRA's work has always been on neuroscience. Our research portfolio includes both clinical and laboratory research into neurological, psychiatric and psychological disorders. Our research activity is organised into five themes:

Ageing & Neurodegeneration: Alzheimer's disease, frontotemporal dementia and other dementias, Parkinson's disease, Motor Neurone Disease, ageing research in indigenous populations, stroke rehabilitation

Brain Structure & Function: brain mapping for research and clinical use, biochemical and structural bases of brain function; development of MRI methods

Neural Injury: spinal cord injury, assessment and prevention of road trauma in children

Mental Illness: schizophrenia, bipolar disorder, depression and autism

Sensation, Movement, Balance & Falls: human movement, fatigue, sleep apnoea, balance and vision, neural control of muscles, falls in older adults, chronic pain

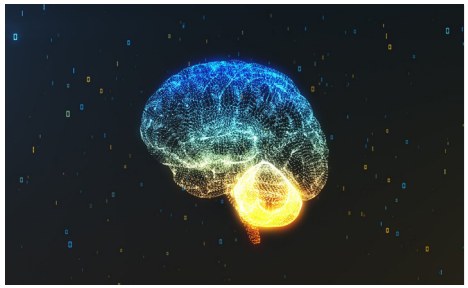
NeuRA houses several specialist research facilities, including the Sydney Brain Bank and Genetic Repositories Australia. The institute has an on-site 3T MRI imaging research facility.

Leadership

Professor Peter R Schofield, FAAHMS PhD DSc, has been the Executive Director and CEO of Neuroscience Research Australia since 2004. Professor Simon Gandevia, MD PhD DSc FAA FRACP, is Deputy Director and was one of four foundation scientists.

Governance

NeuRA is the not-for-profit company that was incorporated on 4 November 1991 to govern the institute. The company was founded by the University of New South Wales and the South Eastern Sydney Local Health District.



The Mindgardens Alliance Establishment Agreement was signed on 22 December 2017 and was passed by board resolution on 8 February 2018. As a consequence, seven directors resigned and were replaced with six new directors.

The aim of the Alliance is to build a world class, internationally recognised, research collaboration, based on the complementary skills and capacity of the Alliance members, UNSW Sydney, South Eastern Sydney Local Health District, Black Dog Institute and Neuroscience Research Australia.

"Our research portfolio includes both clinical and laboratory research into neurological, psychiatric and psychological disorders"

The Board comprises up to 14 directors. There are two nominees each from the founding stakeholders, the University of New South Wales and the South Eastern Sydney Local Health District, plus one nominee from the State via the NSW Minister for Medical Research. There are eight positions for independent directors, and the CEO is also a director. The Chairman is John Grill, BSc BE(Hons) Hon DEng, Chairman at WorleyParsons Limited. The directors are also the sole members of the company. The Board meets bimonthly.

Funding

NeuRA attracts competitive external grant funding from national and international organisations, infrastructure funds from state and federal governments and substantial philanthropic support.

Total peer-reviewed funds for the 2017 calendar year from 129 active grants from 45 funding bodies, totalled $17.29 million. The most significant funding body is the NHMRC which awarded $8.22 million in 2017. This includes 22 Research and Postdoctoral Fellowships, 19 Research Grants, 2 Centres of Research Excellence and 2 Program Grants. The Australian Research Council awarded $0.55 million in 2017, with NeuRA also involved in a $2.7 million Linkage Infrastructure, Equipment and Facilities.

Through the NSW Government's Medical Research Support Program, NeuRA secured $4.5 million in 2017.

NeuRA also received $2.6 million in 2017 from UNSW for research infrastructure.

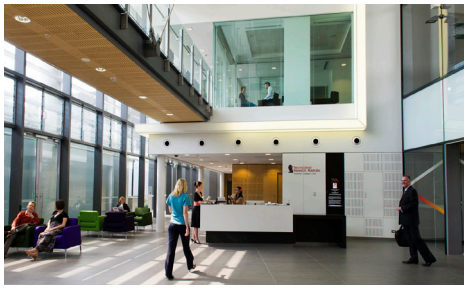
The NeuRA Foundation, established in 2007 to enhance philanthropic fundraising to underpin the activities of the institute, continues to grow. The Foundation raised $6.9 million in philanthropic support in 2017. To date, it has raised $44 million.

Total income in 2017 was $31.3 million and operational expenditure was $21.8 million.

The Neuroscience Research Precinct

The Margarete Ainsworth Building was completed in December 2012 and was officially opened on 23 July 2013 by Health Ministers Tanya Plibersek and Jillian Skinner.

The building provides 8,165m2 of new, purpose-built space, more than doubling our existing research space.



Funding of over $70 million has been secured for this project - $36 million from the Federal Government and $16 million from the State Government, in addition to $22 million from donors and philanthropic organisations.

With the current support of NSW Government and philanthropic funding, fit-out of the remaining floors of the building is complete.

The new building forms the first stage of a four stage development to create a larger Neuroscience Research Precinct, the Mindgardens project.

The precinct development has secured full project planning approvals and will allow the consolidation of the many neuroscience research strengths from the UNSW and the POW Hospital campuses.

Once fully developed, the precinct will provide six stories of research space, 25,000m2 floor space and be able to house up to 700 researchers.

Ageing and Neurodegeneration


PhD/Honours

GROUP: Delbaere
SUPERVISORS: A/Prof Kim Delbaere / Dr Kim van Schooten
EMAIL: k.vanschooten@neura.edu.au

Active and healthy ageing

SUMMARY:

The Delbaere group develops innovative approaches to promote healthy and active ageing. We focus on understanding physical, cognitive and psychological contributors to falls and inactivity. To address these contributors, we employ eHealth interventions to improve balance and promote physical activity. A few examples of topics of interest are:

- The effect of physical exercise on balance and fall risk in older people
- Understanding the relation between cognitive decline and balance recovery
- The effect of depression and fear of falling on daily activity
- Gender inequality in physical activity and exercise adherence
- Development of novel wearable technologies to detect falls and fall risk


PhD/Honours

GROUP: Radford
SUPERVISORS: Dr Kylie Radford / Dr Louise Lavrencic
EMAIL: k.radford@neura.edu.au

Ageing and dementia in Aboriginal Australians

SUMMARY:

The Aboriginal Health and Ageing Program at NeuRA, led by Dr Kylie Radford, works closely with Aboriginal communities in NSW to conduct research and knowledge translation projects with older Aboriginal Australians. The Radford Group focuses on the health and wellbeing of Aboriginal Australians, and ways to support cognitive health into older age.

Through our work with Aboriginal communities and representatives, we have identified enormous interest amongst Aboriginal people in understanding the scope of age-related diseases like dementia; and our research to date has identified an increased prevalence of dementia in Aboriginal communities. Our work takes a life course approach to dementia risk and prevention, through identification of modifiable risk factors for dementia, and translation of our findings into health literacy and prevention strategies. There are a number of current projects currently running, including:

- Identifying social and biomedical risk factors for incident dementia and cognitive decline in older Aboriginal Australians.
- Identifying neuroimaging correlates of dementia and cognitive decline in older Aboriginal Australians.
- Improving aged care and dementia services for older Aboriginal Australians.
- Developing dementia prevention strategies with older Aboriginal Australians, including exercise and cognitive interventions.
- Developing a culturally-safe mindfulness program to promote healing and resilience in Aboriginal people.

Honours

GROUP: Anstey
SUPERVISOR: Dr Ruth Peters
EMAIL: r.peters@neura.edu.au

Modifiable risk factors for cognitive decline and dementia, an assessment of the knowledge landscape amongst primary healthcare providers

SUMMARY:

Our group is interested in healthy brain ageing and ways to prevent or delay the onset of cognitive decline or dementia.

We now know that there are clinical and lifestyle factors that can increase the risk of developing cognitive decline and dementia. These include hypertension, diabetes, high cholesterol, smoking, obesity, excess alcohol and sedentary lifestyle.

We also have some evidence to support risk reduction. Frontline healthcare staff in General Practice (GP) settings have a crucially important role in helping to manage the risk factors for cognitive decline and dementia but research from overseas has shown that these staff may have limited knowledge of the risk factors.

This project will systematically review the literature relating to current awareness of dementia risk factors in frontline healthcare workers and will work on the design, piloting and delivery of a survey aimed at primary healthcare workers (general practitioners and practice nurses) about their current awareness and understanding of risk factors for cognitive decline/dementia, knowledge of current guidelines, areas of strength, possible knowledge gaps and potential barriers/facilitators to implementation.

Brain Structure and Function

PhD

GROUP: Roscioli
SUPERVISOR: A/Prof Tony Roscioli
EMAIL: c.evans@neura.edu.au

The Genomics of Intellectual Disability

SUMMARY:

Neurocognitive Disorders (NCDs) are one of the largest unmet challenges in health care, due to their lifelong nature, high management costs, prevalence and frequent recurrence within families. The development of effective therapies has been hampered by the heterogeneity in the underlying genetic aetiologies, and hence biology, of NCDs.

A dynamic Centre of Research Excellence in Neurocognitive Disorders (CRE-NCD) has been established to transform the diagnosis and characterisation of NCDs through the application of genomic technologies, including whole exome sequencing (WES) and whole genome sequencing (WGS). This will be achieved through a co-ordinated network of experienced clinicians and researchers to enhance fundamental knowledge about the genetic basis of neurocognition and the investigation of targeted treatment strategies in relation to biological pathways. This program will achieve its goals through a national approach with improvements in clinical phenotyping, genomic diagnostics, common data analysis and reporting standards. The aim is that within the next 5 years, all Australians with NCDs will have access to genomic testing, achieving a diagnosis in >50%. A molecular diagnosis with an accurate genotype-phenotype classification is essential for defining an aetiology for families, improving patient management, predicting recurrence risk, and for the successful design of targeted therapeutics.

The CRE-NCD team comprises researchers and clinicians with internationally recognized leadership and track records in neurogenetics research, genomics, bioinformatics, functional analysis, health economics and clinical practice. Several PhD projects are available through the CRE-NCD for highly motivated scientists or physicians across Australia.

PhD

GROUP: Cysique
SUPERVISORS: Dr Lucette Cysique / Prof Caroline Rae
EMAIL: lcysique@unsw.edu.au

Neuroimaging of chronic brain HIV infection

SUMMARY:

HIV persists in the brain of HIV-infected persons despite antiretroviral treatment and viral suppression either in the form of low level of residual/restricted HIV replication and/or the activity of cellular reservoirs (cells that keeps the genetic information of HIV dormant).

The pathogenesis of this chronic level of brain insult is not known. Multi-modal MRI (multi-sequence based morphometric MRI, HARDI, MRS, qASL and resting state fMRI) in addition to novel mode of analyses (e.g., network analyses) have unique potential for contributing to a better understanding of the nature of HIV brain pathogenesis. Collection of cutting-edge multi-modal MRIs in chronic HIV-infected persons and matched healthy controls, coupled with multidimensional analyses will serve as the basis for a new PhD project within the NeuroHIV research group of Dr. Cysique.

It is expected that the project leads to major advancements in the field of brain HIV research and applied neuroimaging with high impact publications.

The project will be conducted in collaboration with Professor of Brain Sciences, Caroline Rae at NeuRA, and Prof. Bruce Brew director of the Peter Duncan Neuroscience Unit at St. Vincent's Hospital Research campus in Sydney.

"It is expected that the project will lead to major advancements in the field of brain HIV research & applied neuroimaging"

Mental Illness


PhD/Honours

GROUP: Schizophrenia Research Laboratory
SUPERVISORS: Prof Cyndi Shannon Weickert / Dr Tertia Purves - Tyson
EMAIL: i.bebris@neura.edu.au

Schizophrenia Research Laboratory - Our Students and the Experiments

SUMMARY:

1. No treatments for schizophrenia or bipolar disorder have been designed to address neuroinflammation, although evidence is accumulating that this is a component of brain pathology in psychotic people. This study will investigate the cells and pathways which contribute and respond to neuroinflammation in psychosis. Understanding these processes may lead to new therapeutic targets which could help to interrupt the inappropriate immune response and restore brain health in disorders with psychosis.

2. New and more effective treatments for people with schizophrenia are needed. The discovery of heightened immune-related activity in the brains and bodies of people with schizophrenia, offers an exceptional and unique opportunity to test if drugs originally developed to treat the immune system, can treat diseases of the mind. Here we propose to determine how a novel biological agent aimed at blocking a potent immune system signalling protein works in people with schizophrenia.


PhD/Honours

GROUP: Schizophrenia Research Laboratory
SUPERVISORS: Dr Tertia Purves - Tyson / Prof Cyndi Shannon Weickert
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Determining the molecular underpinnings of improved cognition induced by estrogen receptor modulation

SUMMARY:

Estrogen replacement has cognitive benefits in healthy older women and estrogen used as an adjunctive to antipsychotics improves cognition in schizophrenia, however, long-term estrogen use has contraindications and estrogen treatment of men causes feminising effects.

Selective estrogen receptor modulators (SERMs) retain the beneficial effects of estrogen in brain, avoiding adverse peripheral effects. The SERM, raloxifene can benefit both cognition and symptoms in schizophrenia.

In our clinical trial, both verbal memory and attention/perceptual-motor processing speed were improved in men and women with schizophrenia (0.6 effect size). Since raloxifene acts on estrogen receptors, which are ligand-gated transcription factors, this raises the following question: Which genes are differentially regulated by raloxifene to contribute to this cognitive improvement?

We hypothesise that specific inflammatory-related and neurotransmitter system-related molecules are involved in raloxifene-mediated brain effects. We will use clinical samples, rodent models and cell culture to determine the molecular pathways modulated by raloxifene. Uncovering the molecular and cellular mechanisms of action of raloxifene and the behavioural correlates that are improved by raloxifene in healthy rodents and in rodents with a schizophrenia-like phenotype will aid in prioritising downstream molecular targets to develop novel treatments aimed at reversing or preventing the MIA-induced cognitive deficits, with a view to translating this information to treatment of the debilitating cognitive deficits of schizophrenia.


PhD/Honours

GROUP: Fullerton
SUPERVISORS: Dr Janice Fullerton / Dr Claudio Toma
EMAIL: j.fullerton@neura.edu.au

Genetic contributors, clinical course and pharmacogenomics of Bipolar Disorder

SUMMARY:

Bipolar Disorder (BD) affects around 350,000 Australians, and its clinical course is highly variable. Treatment often entails a sequential trial-and-error strategy, typically resulting in significant delays in achieving remission.

Of critical importance is the reduced life expectancy of BD patients, with an average loss of 8-12 years of life, due to both a 15-fold increased risk of suicide compared with the general population and increased rates of severe physical illness, particularly respiratory, cardio- and cerebro-vascular diseases.

The specific genetic determinants of BD remain largely unknown, despite clear evidence of a considerable genetic contribution.

Mental Illness

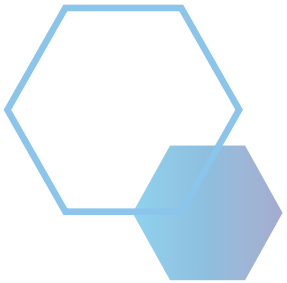
Furthermore, the genetic correlates of clinical course, physical and psychiatric comorbidities, and pharmaceutical treatment response have been poorly explored, requiring both deep-phenotyping and complete genomic data to enable effective analyses.

The Sax Institute's 45 and Up Study cohort comprises 267,000 people aged over 45 years, from across New South Wales (NSW), with detailed health records spanning 15 years via data linkage.

During 2018, we will recruit a new BD cohort from the 45 and Up participants, obtain blood samples, and using strategic Collaborative Genomics funding awarded by the NSW Government, perform whole genome sequencing on 1,200 BD cases.

Through the combined analysis of health-record (phenotypic) data and whole genome sequence (genotype) data, this study will address two key knowledge gaps:

- Characterise the genetic determinants of clinical course and outcomes of BD, focused on common health and psychiatric comorbidities, and their severity
- Identify genetic signatures of treatment responsiveness and resistance to BD medicines.



PhD/Honours

GROUP: Fullerton
SUPERVISORS: Dr Claudio Toma / Dr Janice Fullerton
EMAIL: c.toma@neura.edu.au

The metabotropic glutamate receptor gene (GRM1) in psychiatric disorders: genetic analyses of multiple classes of variants

SUMMARY:

We performed a genome-wide copy number variants (CNV) study in 20 autistic sib-pairs, and found a rare deletion (65 kb) within the GRM1 gene, which segregated in two affected siblings and was absent in a sample of 60,000 controls. The GRM1 gene encodes a metabotropic glutamate receptor that plays an important role in cerebellar development and synaptic plasticity.

This project aims to gain evidence for the involvement of this gene in psychiatric phenotypes by:

- Mapping all reported rare deletions/ duplications across GRM1 in cases and controls to assess their role in psychiatric phenotypes.
- Performing a gene-based association test using the summary statistics from the Psychiatric Genomics Consortium (PGC) GWAS (datasets available in our laboratory) to assess the role for susceptibility common variants in 7 psychiatric disorders.
- Assess the impact if any for de novo variants in risk disease using publically available datasets (>12,000 psychiatric families and >2,000 controls)
- Explore the role for rare pathogenic variants performing a burden test using datasets available in our laboratory in autism (1,800 probands), schizophrenia (6,000 patients), controls (10,000), and our ongoing sequencing project at NeuRA in bipolar disorder (1,200 patients with linkage data).

This project will establish the role of GRM1 as a putative novel candidate gene for psychiatric disorders, and will set the basis for future studies:

- Explore the effect of associated variants in brain changes using imaging data.
- Assess potential links between associated variants in GRM1 and response to medicine dispensed to bipolar patients.

Honours

GROUP: Walker
SUPERVISOR: Dr Adam Walker
EMAIL: a.walker@neura.edu.au

Using glutamate scavenging to treat inflammation-induced depression-like behaviour in mice

SUMMARY:

Neuroinflammation causes the release of excess glutamate from microglial cells and the production of metabolites that agonize the NMDA receptor. Together, these lead to neural excitotoxicity and the development of symptoms of depression.

This project investigates if strategies to scavenge excess glutamate in the brain to the body can treat inflammation-induced depression-like behaviour in mice. We will induce inflammation and depression-like behaviour in mice using a bacterial mimetic (lipopolysaccharide) and determine if treatment with oxaloacetate and pyruvate to metabolise glutamate in the body and create a concentration gradient causing efflux of glutamate from the brain cures the depression-like behaviour.

Mental Illness

Honours

GROUP: Walker
SUPERVISOR: Dr Adam Walker
EMAIL: a.walker@neura.edu.au

Mechanisms of chemotherapy-induced cognitive impairment and depression

SUMMARY:

Cognitive impairment is common in patients receiving chemotherapy, a phenomenon known as chemobrain.

Chemobrain has been associated with impaired neurogenesis, cell death and altered neuronal structure and function.

To date, we still do not know which chemoagents cause chemobrain and if cocktails of chemoagents increase the magnitude or duration of chemobrain compared to treatment with a single drug.

We also do not know if chemobrain is caused by i) a direct cytotoxic effect of the chemotherapeutic agent on cells in the brain or ii) an indirect role of peripheral inflammation that induces neuroinflammation.

Surprisingly, most animal models of chemobrain actually study this in mice without cancer and so the interaction of a non-CNS tumour (capable of inducing cognitive impairment) with chemotherapy on the brain is yet to be explored!

This project investigates the impact of 3 chemoagents commonly used as a cocktail therapy for breast cancer (Adriamycin, Cyclophosphamide and Paclitaxel; ACT therapy).

We will determine if each drug induces cognitive impairment and if cognitive impairment is worse when all 3 drugs are given in combination. We will use mouse models of triple negative metastatic breast cancer and use in vivo bioluminescence imaging to track tumour growth and metastasis. We will investigate inflammatory and metabolic mechanisms in the brain to identify novel targets for intervention.

PhD

GROUP: Walker
SUPERVISORS: Dr Adam Walker / Prof Cyndi Shannon Weickert
EMAIL: a.walker@neura.edu.au

Does aspirin treat cancer-associated cognitive impairmenty?

SUMMARY:

70% of cancer patients report cognitive symptoms and 40% have measurable cognitive impairment. No pharmacological strategies to target the biological mechanisms of cognitive impairment in cancer patients exist. While cognitive impairment associated with cancer has long been attributed to the effect of chemotherapy (CTH), we have shown that the cancer itself is also responsible using mouse models of metastatic breast cancer.

Our discovery that cancer-associated cognitive impairment exists prior to treatment provides an exciting opportunity to intervene as early as cancer diagnosis to treat existing cancer-associated cognitive impairment and to prevent further cognitive decline.

Recently, we showed that a peripheral solid tumour alone is sufficient to induce episodic memory impairment by inducing neuro-inflammation, and can be prevented by a cheap and safe anti-inflammatory drug aspirin. Our preliminary evidence is compelling but many questions remain before clinical trials can begin.

This PhD project will use mouse models of breast and colorectal cancer to determine the mechanisms of action through which non-CNS tumours hijack the brain and the capacity of aspirin and other anti-inflammatory drugs to be repurposed to the cancer clinic to combat cancer-associated cognitive impairment.

The potential to conduct clinical trials associated with cognition in cancer patients related to the animal work is also possible.

"Our preliminary evidence is compelling but many questions remain before clinical trials can begin"

Sensation, Movement, Balance and Falls

PhD/Honours

GROUP: Butler
SUPERVISORS: Dr Euan McCaughey / Prof Jane Butler
EMAIL: e.mccaughey@neura.edu.au

Abdominal Functional Electrical Stimulation to improve function

SUMMARY:

Abdominal Functional Electrical Stimulation (Abdominal FES) is the application of a train of electrical pulses to the abdominal muscles, causing them to contract.

We have previously shown that Abdominal FES can improve respiratory function, with our recent research showing that it may also be a viable method to reduce mechanical ventilation duration.

We are now expanding this research area by running clinical trials to investigate how Abdominal FES can improve respiratory and bowel function, and reduce respiratory function, in a number of disease states including spinal cord injury, critical illness and MS.

Epidemiology projects are also available investigating life expectancy after spinal cord injury across 3 continents, amongst others.

PhD/Honours

GROUP: Butler
SUPERVISORS: Dr Anna Hudson / Prof Jane Butler / Prof Simon Gandevia
EMAIL: a.hudson@neura.edu.au

How is the neural control of breathing altered in the elderly and in lung disease?

SUMMARY:

Respiratory muscle function is critical for ventilation.

Our laboratory uses specialised neurophysiological methods such as electromyography (EMG), electroencephalography (EEG) and transcranial magnetic stimulation (TMS) to investigate the control of breathing. We are the only lab in the world to use some of these methods in human subjects.

The public health burden of an ageing population presents a myriad of challenges for Australia. Ageing leads to major changes in lung and chest wall mechanics that decrease breathing capacity. On top of this, there is a loss of respiratory muscle strength with age. The changes are accelerated in chronic obstructive pulmonary disease (COPD), a deteriorating lung disease with major changes in lung and chest wall mechanics, respiratory muscle weakness and symptoms of breathlessness and chronic cough. COPD is Australia's 5th leading cause of death.

A reduced breathing capacity is an important health issue associated with ageing and COPD and leads to significant morbidity and mortality including pneumonia, aspiration and weak cough. We want to determine how the neural control of breathing is altered in the elderly and in COPD. If respiratory neural control is impaired, we will identify a major novel target for treatment that has the potential to reduce the disability, disease burden and direct health costs associated with respiratory morbidity and respiratory failure, particularly in the elderly. We have a range of projects available on fundamental respiratory physiology and on how the neural control of breathing is altered in

PhD/Honours

GROUP: Schabrun
SUPERVISORS: Dr Siobhan Schabrun / Dr David Seminowicz
EMAIL: s.schabrun@neura.edu.au

Understanding brain plasticity and predicting recovery in musculoskeletal pain

SUMMARY:

Chronic musculoskeletal pain is a major global health problem. Costs have risen faster than for any other health condition and chronic pain is now equal to ischemic heart disease, and second only to cancer, as the costliest health condition .

The enormous scale of the problem is matched only by the mystery that accompanies it: despite decades of research, why some people develop chronic pain while others do not, remains unknown.

The identification of biomarkers that can predict who will develop chronic musculoskeletal pain is a holy grail of pain research yet, investigations in this area have had limited success.

Sensation, Movement, Balance and Falls

Our innovative and exciting research has revealed two unique cortical biomarkers that appear to predict i) an individual's susceptibility to high pain severity, even before pain begins and ii) an individual's susceptibility to developing chronic musculoskeletal pain following an acute episode.

Our research groups (Schabrun, Seminowicz) are working collaboratively to explore these biomarkers in depth, using human pain models and longitudinal prospective cohort studies in clinical populations. We use a range of experimental and clinical research techniques including non-invasive brain stimulation, fMRI, EEG, EMG, spinal and peripheral stimulation, collection of blood and salvia for genotyping and assessment of endocrine and immune function as well as assessment of psychosocial factors. All our studies are conducted in humans.

We are looking for talented and highly motivated Honours and PhD students who are passionate about neuroscience and/or pain to work on a range of projects in this area. Scholarship funding is available.

PhD/Honours

GROUP: Schabrun
SUPERVISOR: Dr Siobhan Schabrun
EMAIL: s.schabrun@neura.com.edu

Boosting the brain's response to therapy in musculoskeletal pain

SUMMARY:

Chronic musculoskeletal pain is a highly prevalent and costly health condition. Despite considerable research effort, effective treatment remains elusive. Indeed, traditional therapies including exercise and multidisciplinary rehabilitation produce at best, marginal effects in people with chronic pain.

Our group is exploring a fresh approach to the treatment of chronic pain by using non-invasive brain stimulation to alter cortical network excitability and 'prime' the brain - making it more receptive to the effects of traditional therapies.

Our pilot data in people with knee osteoarthritis and low back pain suggest this approach may double improvements in pain and disability compared with traditional therapy alone.

Using randomised controlled clinical studies we are extending our pilot work to determine the efficacy of this new model of treatment.

In addition, we will strengthen our clinical trials by embedding a parallel investigation of brain mechanisms - allowing us to understand not only whether a treatment works, but how it works and who is likely to derive greatest benefit.

We are looking for talented and highly motivated Honours and PhD students with an interest in neuroscience and/or pain to work on projects in this area. All our work is conducted in humans and we use a range of neurophysiological research techniques including non-invasive brain stimulation, EEG, EMG, spinal and peripheral stimulation as well as clinical assessments of pain, disability and psychosocial factors.

PhD/Honours

GROUP: Herbert
SUPERVISORS: Prof Robert Herbert / Dr Bart Bolsterlee
EMAIL: b.bolsterlee@neura.com.edu

Diffusion tensor imaging of human skeletal muscle in health and disease

SUMMARY:

Muscles are composed of many muscle fibres. The orientations and lengths of muscle fibres determine how much force a muscle can produce so these properties, referred to as muscle architecture, are very important for the muscle's function.

In the last several decades, researchers have measured these properties using ultrasound imaging. By placing an ultrasound transducer on the skin overlying a muscle, a two-dimensional image of the muscle is obtained from which fibre lengths and orientation can be measured. But muscles have complex, three-dimensional shapes, which makes measuring their properties with ultrasound difficult and inaccurate.

In the last decade, a new magnetic resonance imaging (MRI) technique has emerged to measure the diffusion properties of tissues, which provides detailed information on three-dimensional muscle structure. This technique is called diffusion tensor imaging or DTI.

Researchers at NeuRA have recently developed DTI-based techniques to make exquisite three-dimensional reconstructions of muscle fibre architecture and are now applying these techniques to study both healthy and diseased muscles.

Joint contracture is one of the important clinical problems that we study. Joint contractures, a loss of the passive joint range of motion, are a major cause of disability in several patient groups including stroke survivors, patients with multiple sclerosis and children with cerebral palsy.

We are looking for undergraduates, Honours, Master's or PhD students who are interested in solving clinical problems using DTI techniques or who want to further develop this state-of-the-art technology in a research team composed of physiotherapists and biomedical engineers.

Sensation, Movement, Balance and Falls

PhD/Honours

GROUP: Seminowicz
SUPERVISORS: Dr David Seminowicz / Dr Siobhan Schabrun
EMAIL: d.seminowicz@neura.com.edu

Functional MRI and EEG of pain and cognition

SUMMARY:

We investigate brain functional and structural changes associated with acute and chronic pain, using EEG and MRI. Ongoing studies include clinical trials with longitudinal neuroimaging outcomes, the interaction between cognitive and pain-related networks in ongoing clinical and experimental pain, and cross-sectional comparisons between patients and controls. Patient groups include migraine, chronic orofacial pain, and chronic low back pain.

Some of our most recent work includes:

- EEG predictive biomarkers of pain
- Reward circuitry in sleep, pain, and positive affect
- Role of the claustrum in cognitive control
- Dorsolateral prefrontal cortex stimulation to block pain
- Mindfulness meditation as a treatment for migraine

PhD/Honours

GROUP: Birznieks
SUPERVISORS: Dr Irngvars Birznieks / Dr Richard Vickery, Dr Heba Khamis
EMAIL: i.birznieks@neura.edu.au

Tactile sensorimotor control of the human hand: neural code, psychophysics, prosthesis and bionics

SUMMARY:

Our senses define our existence and determine how we perceive the world in which we live.

The research in our laboratory primarily comprises a range of studies related to the function of tactile receptors in the skin and sensorimotor control of human hand. However, our ultimate goal is to use this fundamental knowledge and foster two branches of collaborative networks: one with clinicians, which aims to develop new methods for evaluation of sensorimotor function in different groups of patients, while the second branch aims at working with biomedical engineers to create artificial sensors and control algorithms for prostheses and robotic manipulators resembling functionality of the human hand.

There are several research methodologies and methods you can learn in our laboratory:

- Human microneurography: a unique method which allows us to tap into the signals that single sensory axons are sending to the brain. Using fine needle electrodes inserted into a peripheral nerve we are able to analyse tactile neural signals in awake humans with a precision and resolution previously available only in animal experiments.
- Psychophysics (controlled, objective studies of perception).
- Computer modelling, simulations, robotic control (collaboration with biomedical engineers).
- Investigations in patients (stroke, diabetic neuropathy).

We welcome students with a science, medical science, psychology, engineering or computer science background. We have various projects suitable for students with any background knowledge, no special technical skills required.