



NeuRA

Discover. Conquer. Cure.

Honours & PhD Student Projects



Neuroscience Research Australia
Margarete Ainsworth Building, Barker Street, Randwick

Welcome to NeuRA

Our Vision & Mission: "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 33 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, Enquiry, Human Impact, Respect, Excellence, Accountability

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, on-site MRI scanning, 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 August 1993 to govern the institute. The company was founded by the University of New South Wales and the Eastern Sydney Area Health Service.

The Board comprises up to 14 directors. There are two nominees each from the founding stakeholders, UNSW and the SESLHD, plus one nominee each from the Commonwealth via the NHMRC and the State via the NSW Minister for Medical Research. There are seven positions for independent directors, and the CEO is also a director. The Chairman is Paul Brassil, BEc LLB FCA FTIA CTA, a partner at PricewaterhouseCoopers. The directors are also the sole members of the company. The Board meets bimonthly.

Funding

Total income in 2014 was \$23.5 million and operational expenditure was \$23.6 million. NeuRA attracts competitive external grant funding from national and international organisations. Total peer-reviewed funds for the 2014 calendar year were \$11.5 million.

The most significant funding body is the NHMRC which awarded \$9.7 million in 2014. This includes 28 research and postdoctoral fellowships and scholarships and 41 research grants. NeuRA hosts two NHMRC Program Grants and is a partner in a third Program Grant. The Australian Research Council awarded \$1.2 million in 2014, which includes a Discovery Early Career Award and a node of a Centre of Excellence. Through the NSW Government's Medical Research Support Program, NeuRA secured \$2.4 million in 2014. NeuRA also received \$2.3 million in 2014 from UNSW for research infrastructure. The NeuRA Foundation continues to grow, raising \$4.4 million in 2014. To date, it has raised \$27 million, with additional pledges of over \$7.5 million.

Neuroscience Research Precinct

The Margarete Ainsworth Building was completed in 2012 and was officially opened in 2013 by Health Ministers Tanya Plibersek and Jillian Skinner. When fitout is complete the building will provide 8,165m² of new, purpose-built space, more than doubling existing research space. NeuRA has obtained total funding of \$54 million for this project - \$36 million from the Federal Government and \$6 million from the State Government, in addition to \$22 million from donors and philanthropic organisations. A \$10 million donation by Margarete Ainsworth to help complete the fitout was recognised by naming of the building. A commitment to match Mrs Ainsworth's donation was made by Health and Medical Research Minister Jillian Skinner in the 2015 NSW election.

The new building forms the first stage of a development to create a larger Neuroscience Research Precinct, the Mindgardens Neurosciences Project. The precinct development secured full concept and project planning approvals from the NSW Government in 2010 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 25,000m² of research space over six stories and house up to 700 researchers.

Ageing and Neurodegeneration



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Novel pathomechanisms and therapies in Alzheimer's disease

➤ Honours

Alzheimer's disease (AD) is the most prevalent neurodegenerative disorder with no cure available. With an aging population, AD is becoming a major health threat worldwide. It is critical to understand what causes neurons to die in the diseased brain, in order to develop novel therapies for AD and related conditions of the aging brain. Here, the research of Lars and his team aims to identify novel molecular pathomechanisms underlying neurodegeneration, and then translate these findings into new therapeutic approaches. Their cutting-edge research utilizes a wide range of techniques, including latest transgenic mouse models and complementary neuronal cell culture systems, and has been published in top-ranked international journal, such as *Cell*, *PNAS* and *Nature Reviews Neuroscience*.

In the AD brain, there is deposition of two proteins; namely amyloid- β in extracellular plaques and the microtubule-associated protein tau in intracellular tangles. For long, tau has been thought to

localize exclusively to the neuronal axon, accumulating in other cell compartments only during disease.

Challenging this view, we revealed that tau normally also localizes to the dendritic compartment of neurons, functioning as a post-synaptic scaffolding protein. The aim of the proposed Honours projects is to reveal novel pathomechanisms involving tau, provide a deeper understanding of the functional relevance of dendritic tau, and decipher the exact molecular interplay between tau and amyloid- β . These studies involve establishing and analysis of new disease models, including the generation of novel transgenic mouse lines in our in-house transgenesis facility.



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"Back to the Future" - exploring memory and imagination in dementia

- PhD
- Honours

The ability to remember the past represents one of the most fascinating and complex abilities that humans possess.

Episodic memory allows us to remember events that have occurred in our lives, ranging from very recent experiences and extending all the way back to the distant past. These memories are essential for a sense of identity and continuity across subjective time, and are disrupted in neurodegenerative disorders.

A distributed network of brain regions supports the capacity to remember past events, reflecting the multifaceted nature of episodic memory. Importantly, recent work has demonstrated that the brain regions essential for remembering the past are also crucial for mentally simulating or imagining the future.

Recent studies conducted by our group in neurodegenerative disorders reveal that damage to specific regions in the brain disrupts the ability to imagine the future. The precise neurocognitive mechanisms mediating these deficits remain unclear.

Several projects are available for PhD and Honours students to investigate:

- ◆ The neural circuitry underpinning future thinking
- ◆ The relationship between memory and imagination
- ◆ How imagination allows us to construct the social world
- ◆ How imagination relates to other complex cognitive functions

Students will gain skills in experimental design, clinical and cognitive assessment, and advanced neuroimaging techniques (e.g., voxel-based morphometry, diffusion tensor imaging) while working in a multidisciplinary and stimulating setting.



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The brain and behaviour in dementia

- **PhD**
- **Honours**

Frontotemporal dementia strikes people in their 50s and 60s. Unlike other types of dementia, such as Alzheimer's disease, frontotemporal dementia is characterised by marked changes in personality and behaviour. Individuals become less empathetic and increasingly disinhibited. They can show sexually inappropriate behaviour, lose motivation and become increasingly compulsive. Alternatively, patients can develop difficulty in understanding language, or language expression. In addition, some patients develop motor impairments.

The FRONTIER group has been investigating patients with frontotemporal dementia and related conditions, such as ALS, or corticobasal syndrome since 2007. We have assessed and scanned over 500 patients to date.

Our research has two broad aims:

1. To improve diagnosis and prognosis of individuals affected by younger-onset dementia; and
2. To inform current models of brain-behaviour relationships, using dementia as a lesion model.

To achieve these aims, we employ clinical, neuropsychological and experimental tests of cognition together with advanced neuroimaging (e.g. MRI, MEG) and neurophysiological techniques (e.g. EMG, heart rate and skin conductance) to assess dementia patients and healthy matched controls.

Several projects are available for PhD and Honours students to investigate:

- ◆ Social cognition and emotion processing - What parts of the brain are involved in social cognition?
- ◆ Language - How can we assess language impairment?
- ◆ Memory - How is memory affected? Is this different to Alzheimer's disease?

Brain Structure and Function



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Brain biochemistry and function

- **PhD**
- **Honours**

1. How does enzyme acetylation and silent information regulator 1 affect neuronal metabolism? This project will use a range of techniques from NMR spectroscopy to gene manipulation to study how metabolism in neurons is altered by NAD⁺ availability and SIRT activity. It will be conducted in collaboration with Assoc Prof Matthias Klugmann (SOMS).

2. Rethinking metabolomics for the future challenge of big data visualisation. Metabolomics currently works by reducing data to principal components or by constructing correlation networks. We are working on a new approach, SPACE, which allows us to view the most important parts of a metabolic network. If you are interested in programming and developing new analysis methods and have a knowledge of some maths and statistics, this project could be for you.

Mental Illness



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SUPERVISOR
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Shining a light on schizophrenia

- PhD
- Honours

The Schizophrenia Research Laboratory (SRL) endeavours to define the biological basis of schizophrenia. Our group leads a translational research program that uses insights from the molecular and cellular neurodevelopment of schizophrenia to design and test novel treatments for people with schizophrenia. For example, with the help of clinical colleagues, we have translated basic discoveries on estrogen receptor disruption to model systems and then into a successfully completed clinical trial using a selective estrogen receptor modulator (SERM) for people with schizophrenia.

Current student projects in the SRL include studies of the molecular basis of raloxifene modulation of dopamine signalling in schizophrenia, which uses both preclinical rodent studies and human postmortem brain tissue to better understand how sex steroid signalling is altered in

schizophrenia and the impact of SERMs on this signalling. Using blood components (serum, plasma, mRNA) we wish to test if the therapeutic action of SERMs involves attenuation of pro-inflammatory cytokines. Proinflammatory cytokines may negatively impact blood brain barrier integrity in individuals with psychosis. We are looking to test this hypothesis using postmortem brain tissue and serum and an in vitro endothelial cellular model. Additionally, we are interested in characterising cell-type specific deficits in NMDA receptor subunit expression in schizophrenia and in transgenic animal models using in situ hybridisation techniques in order to better delineate the NMDA receptor contribution to the pathophysiology of schizophrenia. This research will inform the development of pharmacotherapies for schizophrenia.



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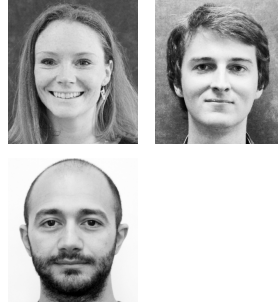
Weickert lab Honours and PhD projects in schizophrenia research

- PhD
- Honours

Canakinumab add on treatment for Schizophrenia:

We have found a relationship between elevated peripheral cytokine levels, and cognitive and brain volume reductions, in a substantial proportion of people with schizophrenia.

IL-1 beta is one of these elevated cytokines. We have recently begun a clinical trial for people with schizophrenia who have elevated cytokine levels that uses a monoclonal antibody treatment designed to specifically reduce IL-1 beta levels. We expect that treatment with the monoclonal antibody (canakinumab) will reduce symptom severity and improve cognitive abilities in people with schizophrenia.



Selective Estrogen Receptor Modulator (SERM) study for treatment of schizophrenia:

We have found abnormal estrogen receptors in the brains of both men and women with schizophrenia. In an attempt to stimulate these abnormal estrogen receptors we have conducted a clinical trial using the SERM raloxifene to reduce symptom severity and improved cognitive abilities in men and women with schizophrenia. While we did find that the SERM raloxifene improves memory and attention in men and women with schizophrenia, we are continuing to test for biomarkers that will predict treatment response in schizophrenia.

Dopamine D2 Receptor (DRD2) and NMDA Receptor (NMDAR) genotype effects on cognitive abilities and symptom severity in people with schizophrenia:

We will test the extent to which DRD2 and NMDAR genotypes will predict cognitive abilities in a large cohort of 534 people with schizophrenia or schizoaffective disorder relative to 635 healthy adults from across Australia.

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Rare variant contributions to the genetic architecture of bipolar disorder: utilizing extended families with highly penetrant forms of illness

- PhD
- Honours

Bipolar disorder is a highly heritable illness, characterized by shifting periods of mania and depression, for which the genetics is largely unknown. The number of genes implicated is estimated to be high, with each one contributing to an individual's disease risk. Our group is using several genetic approaches with the aim of identifying key genes involved in bipolar disorder.

We selected 15 families with at least 4 bipolar patients, as these families are likely to carry rare, strongly pathogenic mutations that play a major role in inheritance of the disorder. As these key mutations are expected to have occurred within the coding portion of the genome, we performed whole exome sequencing (WES) of family

members, both those affected and those unaffected with bipolar disorder. We then used WES data to power linkage analyses that allow us to narrow down genomic regions of interest. Finally, we performed genome-wide copy number variant (CNV) analysis to identify the larger DNA deletions or duplications spanning protein coding sequences.

A research project in our group would be based one of three genetic approaches: WES, linkage studies, or CNV analyses. Projects are available to examine how different loci contribute to disease risk both within and across individual families. Honours or PhD students will gain knowledge in novel bioinformatics methods required for data analysis as well as genetic analysis in the laboratory. The outcome of these projects will be pinpointing genes and pathways that may contribute to the pathophysiology of bipolar disorder.



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Resilience in the brain: factors influencing well-being and risk of mental illness

- **PhD**
- **Honours**

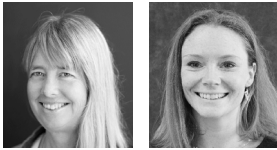
Mental health is not simply the absence of mental illness; rather it is a distinct entity representing wellness. Despite the significant advancements in the neurogenetics for mental illness, the identification and validation of potential endophenotype markers of risk and resilience remain to be elucidated.

The TWIN-E study (The Twin study in Wellbeing using Integrative Neuroscience of Emotion) aims to validate endophenotype markers of mental health across cognitive, brain, and autonomic measures by testing the heritability, clinical plausibility, and reliability of each of these measures in a large adult twin cohort.

TWIN-E is a national prospective study with three phases: I) baseline testing on a battery of online questionnaires and cognitive tasks, and EEG, MRI, and autonomic testing; II) 12-month follow-up testing on the online assessments; and III) randomized controlled trial of brain training over a 30-day period to test the effects of brain training on mental health.

A scale of wellbeing (COMPAS-W) was developed and its subcomponents showed construct validity against psychological and physical health behaviors, high internal consistency ($r=0.84$), and 12-month test-retest reliability ($r=0.82$), with a moderate contribution of genetics (heritability $h(2)=48\%$).

This project will utilize genome-wide genotype data for this cohort of 1560 healthy adult twins (18-61 years) to validate twin zygosity and for exploration of genotype versus environmental effects on brain imaging ($n=228$) and EEG measures ($n=385$).



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Neurodevelopmental trajectories in young people at high genetic risk for bipolar disorder

- PhD
- Honours

Bipolar disorder is a mood disorder which is characterized by oscillating periods of mania and depression. These can escalate to include psychotic episodes and impulsive and risk-taking behavior that can lead to social and financial ruin, with reversion to otherwise normal mood and behavior in between episodes.

Bipolar disorder is highly heritable, with family members of affected individuals having an increased risk of developing bipolar disorder themselves, as well as a variety of other mental disorders.

Although bipolar disorder is typically diagnosed in young adulthood, many affected individuals have had emotional or behavioral symptoms for years before, suggesting that these genetic vulnerabilities affect their neurodevelopmental trajectory long before their first manic episode. Understanding how genetic risk for bipolar disorder alters brain development is critical to understand the pathophysiology

of the disorder, and perhaps recognize those who are most vulnerable in order to intervene before symptoms reach their full form.

This project involves combining longitudinal genetic, clinical, and brain imaging data in a cohort of young people who have first degree relatives with bipolar disorder in order to determine how genetic risk affects structural brain development, and in turn how these differences relate to the likelihood of developing psychopathology.

Neural Injury



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SUPERVISOR
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Developing and using novel MR imaging methods and computational models to understand how mechanical forces affect the human body in health and disease

- PhD
- Honours

Mechanical forces affect the body in a multitude of ways. They are essential for maintenance of normal tissue mass and function, but abnormal or excessive loading can cause dysfunction or injury. Moreover, tissue stiffness can be altered in many clinical conditions, so changes in stiffness can be indicators of disease. We have developed novel MR imaging methods to non-invasively image the mechanical behaviour of the brain, liver and muscle tissues and how these change during development, growth and in disease.

Student projects are available in the following areas, ranging from basic science studies through to preclinical and clinical research:

- ♦ Improving biomechanical MR imaging methods such as elastography and tagged MRI to better detect changes in soft tissue in health and disease (muscle, brain, liver, kidneys etc)

- ♦ Development of 'phantoms' for developing and validating new biomechanical imaging methods
- ♦ Memory - Computational modelling of CNS disorders (hydrocephalus, syringomyelia) and obstructive sleep apnoea, based on clinical and preclinical imaging and physiology data



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Tactile information encoding and sensorimotor control of the human hand (fundamental neuroscience, stroke, prosthesis and robots)

- PhD
- Honours

Our senses define our existence and determine how we perceive the world in which we live. Our main aim is to investigate how sensory organs work and, in particular, how sensory information is encoded and how it is processed and interpreted.

A specific methodological signature research performed in our group is the use of microneurography - a highly skilled neurophysiological technique which enables us to record nerve impulses (messages) generated by a single sensory ending, such as a touch receptor in the skin, in awake humans.

There are many things to discover, not just to increase our understanding of fundamental neuroscience, but to help people who have lost part of their sensory function due to illness or trauma. We can also borrow ideas from biological systems and in collaboration with biomedical engineers develop future technologies.

The research in our group primarily comprises a range of studies related to the function of tactile receptors in the fingertip skin and sensorimotor control of human hand. We apply this fundamental knowledge to develop new methods for evaluation of sensorimotor function in different groups of patients. As well, our work is tightly linked with biomedical engineering aimed to create artificial sensors and control algorithms for prosthetic devices and robotic manipulators resembling functionality of the human hand.

Sensation, Movement, Balance and Falls



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SUPERVISORS

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quality of life and sleep-disordered breathing in health and disease. Respiratory muscle training is likely to improve muscle strength but is currently not routine clinical practice due to a lack of high quality evidence-based research. Specific disease states that would be examined would include mild-moderate obstructive sleep apnoea, spinal cord injury, stroke and motor neuron disease.

Respiratory muscle training in health and disease to improve lung function, obstructive sleep apnoea and swallowing

- PhD
- Honours

Muscle training improves the strength of weak muscles, including respiratory muscles and those muscles we use to swallow, in healthy individuals and people with neuromuscular disorders. Despite this, respiratory muscle training has not been translated into common clinical practice because previous research has produced inconsistent and inconclusive results due to varied training methods and small participant numbers.

Our laboratory proposes to conduct physiological studies and randomised controlled trials to provide critical knowledge, which can be applied clinically, about the effects of increased strength on respiratory complications, swallowing,



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SUPERVISORS

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

- PhD
- Honours

Respiratory muscle function is critical for ventilation. Our laboratory uses specialised neurophysiological methods such as electromyography, electroencephalography and transcranial magnetic stimulation to investigate the control of breathing.

We are the only laboratory 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 fifth 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 healthy ageing and in people with COPD.



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“Standing Tall” - An engaging balance exercise program using iPad technology

➤ **Honours**

Background: We have developed a balance exercise program for older adults delivered through iPad technology called Standing Tall. The program offers tailored, progressive balance training with an in-built coach to encourage adherence. A large randomised control trial is currently underway in 500 healthy community-dwelling older people to determine the program's efficacy for fall prevention.

Aim: In a series of pilot studies, we aim to examine feasibility, acceptability and safety of the program in clinical populations who would benefit from a balance exercise program (e.g., stroke survivors) and establish whether any modifications are required to improve its suitability.

Methods: Participants will be asked to complete up to two hours of exercises per week for three months with the assistance of carers. The exercises will be tailored to the participant's balance abilities for the duration of the trial. The dose gradually increases from 40 min per week to 120 min. The intensity of the balance exercises is adjusted as performance improves to

ensure that exercises remain challenging. Progression of training intensity is guided by an inbuilt coach based on data from recent training activity. Semi-structured interviews will also be conducted to investigate participants' experience and suggestions for improvement to enhance participation and long term adherence and establish facilitators and barriers to adherence.

Significance: If the program is found to be feasible and safe in clinical populations, the goal will be to test its efficacy in a larger study to determine its effectiveness on clinical outcome measures.



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Computational Modelling of the Upper Airway in Obstructive Sleep Apnoea

- **PhD**
- **Honours**

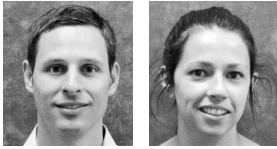
Obstructive sleep apnoea (OSA) is a common chronic disorder characterised by repetitive episodes of upper airway collapse and breathing obstruction during sleep. These episodes lead to recurrent drops in blood oxygen levels and arousals from sleep (partial awakenings), which are thought to be responsible for the disorder's

adverse health outcomes, including excessive daytime sleepiness, cardiovascular disease and neurocognitive dysfunction.

The causes of upper airway collapse are associated with complex interactions between neural, biomechanical and physiological factors that are not well understood. In a bid to better understand these interactions, we developed a two-dimensional computational finite element model of the rabbit upper airway and surrounding pharyngeal tissues. The model is capable of simulating loads known to influence upper airway function (e.g. mandibular advancement) and provides outcomes associated with upper airway lumen geometry and pharyngeal tissue mechanics.

We are now looking to build upon this model in a project that will involve improving its anatomical representation and physiological function. These model enhancements will allow for additional physiological influences to be simulated, including pharyngeal airflow and muscle activity. The project will involve additional finite element modelling, as well as computational fluid dynamics and fluid-structure interactions.

Separate projects are also available to translate the computational animal model to a human upper airway model. These computational models will help significantly advance our knowledge of OSA pathophysiology and provide insights into potential new targeted therapies for OSA.



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- ◆ Developing new approaches to measuring and quantifying sleep apnoea severity and its consequences

These multidisciplinary projects would suit students with backgrounds and interests in one or more of the following:

Physiology, Neuroscience, Medicine, Biomedical Engineering, Psychology and Pharmacology.

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***Human Upper Airway Physiology,
Sleep and Breathing Research
at NeuRA***

- PhD
- Honours

Our lab focuses on determining the causes of sleep-disordered breathing, identifying new therapeutic targets and testing and developing new targeted therapies.

We currently have 10 projects running ranging from basic sciences, human upper airway physiology, mechanistic studies to multi-centre clinical trials investigating new targeted therapies for sleep and respiratory disease.

Examples of Honours and PhD projects that we will have on offer next year include:

- ◆ Examining the effects of a new combination of drugs on upper airway muscle activity during sleep as a new therapeutic target for sleep apnoea
- ◆ Determining the effects of upper airway muscle training on upper airway physiology and sleep apnoea severity
- ◆ Assessing respiratory sensation in people with insomnia and sleep apnoea



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- 1. Ownership and proprioception of the human hand***
- 2. Human motoneurone fatigue and recovery***

- PhD
- Honours

Our laboratories have a long-standing interest in fundamental aspects of sensory and motor control.

A first theme for prospective students include how do our proprioceptive senses contribute to control movements and postural adjustments.

A second possible theme is how does the brain drive the motoneurons and muscles, particularly under circumstances when the muscle's performance changes, such as during fatigue.

Much of our work is at the interface between human neurophysiology and translation into understanding pathophysiology in many clinical conditions, including stroke spinal cord injury.



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Studying healthy and diseased muscles with diffusion tensor imaging: a novel three-dimensional MRI technique

- **PhD**
- **Honours**
- **Masters**

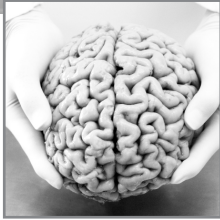
Muscles are composed of many muscle fibres. The orientations and lengths of muscle fibres determine how much force a muscle can produce so these properties, referred to as muscle architecture, are very important for the muscle's function.

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, Masters 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.



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 <http://www.neura.edu.au/why-study-at-neura>.