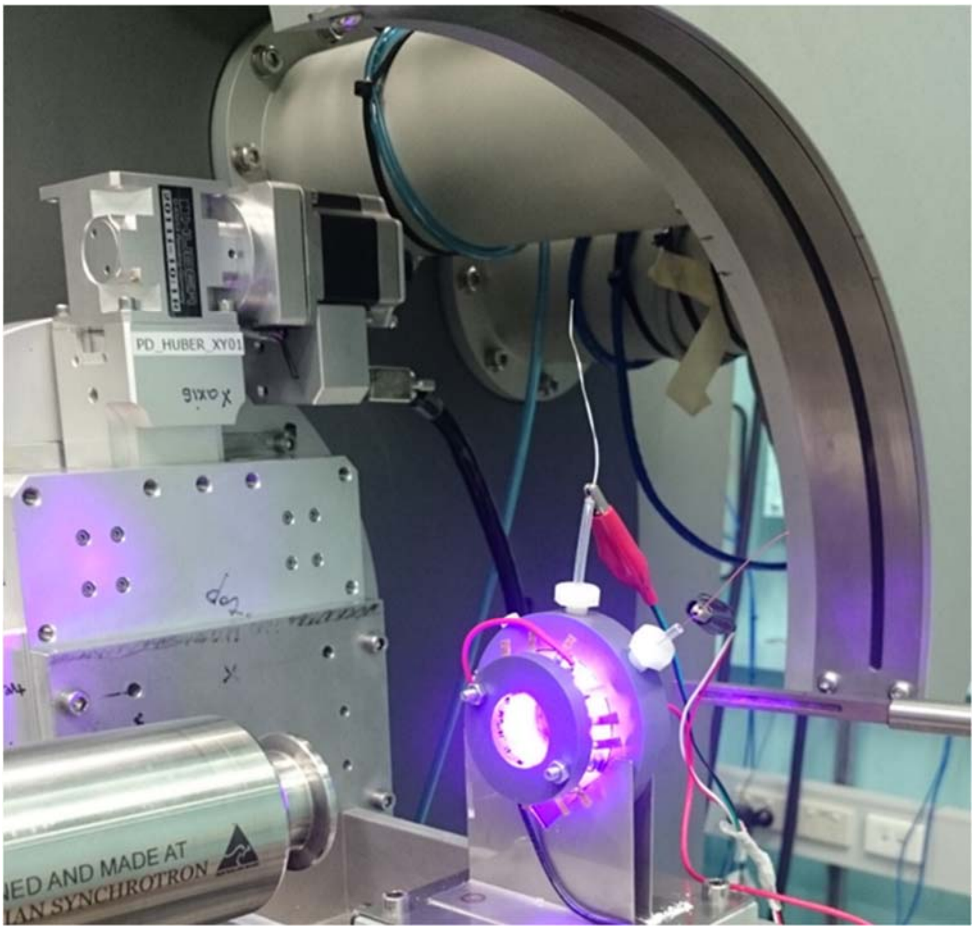
Faculty of Science

Talented Students' Program Research Areas 2017



Introduction

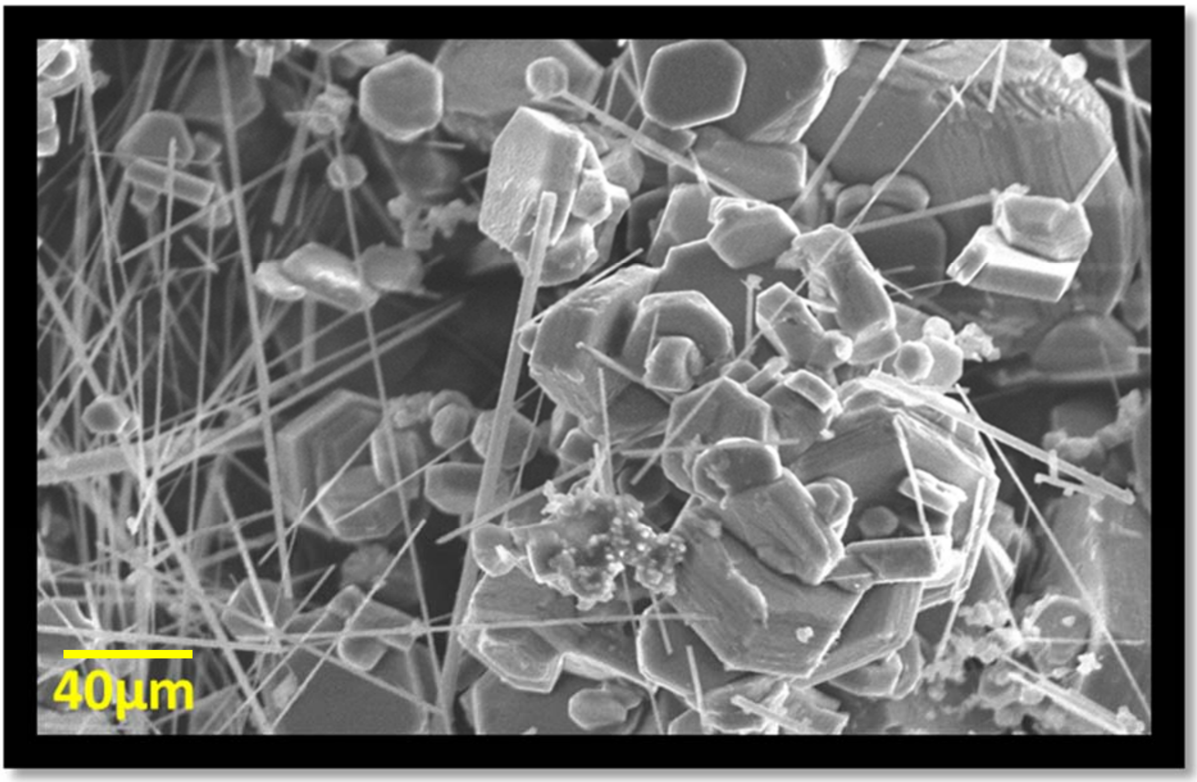
This information package contains outlines of the research interests of some of the high profile researchers from the various Schools across the Faculty of Science at the University of New South Wales along with directing you as to where you might find even more information. We also have contributions from members of staff in the School of Medical Sciences in the Faculty of Medicine; this School contributes significantly to several majors in the B. Sc. and B. Adv. Sc. programmes.

You are strongly encouraged to read through the descriptions of research areas contained here and to browse the research pages of the Schools listed. Along with giving you an indication of the breadth of interests of academics at the University of New South Wales, it will allow you to consider what research groups you might want to consider being involved with through the mentoring portion of the Talented Students Programme (TSP).

Assignment of mentors is carried out at the School level by a TSP coordinator in that School. This means that initially you will be allocated to a School (after discussion with the Directors) from which point your mentors will be assigned. We hope that this will ensure a high degree of interaction with the School.

We hope you have a fun and productive year.

Assoc. Prof. Joel Pearson & Dr. Neeraj Sharma
Directors, Talented Students Programme



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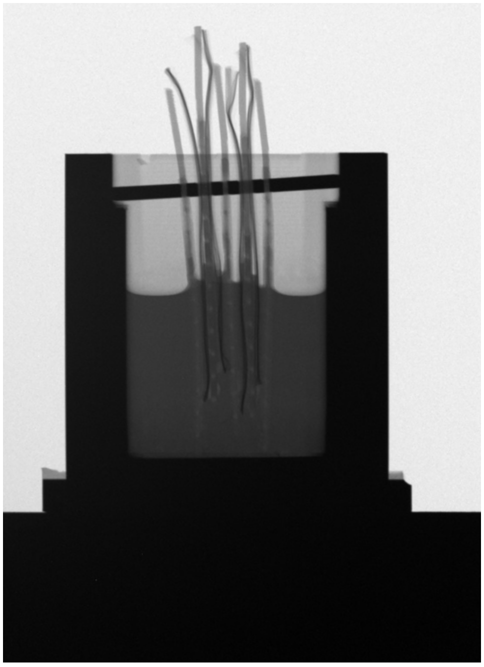

School of Biotechnology and Biomolecular Sciences

www.babs.unsw.edu.au

School Contact:

Dr Irina Voineagu
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Prof. Bill Ballard: Free radicals, nutrition and ageing

It is a combination of the food we eat and our genes that determines how we age. We are investigating both sides of the evolutionary paradox using organisms as distinct as fruit flies and humans. A focus of our studies is the mitochondrion, which is responsible for 80% of our energy production but also produces free radicals that damage DNA. An overall goal is to understand how the interaction between diet and disease leads to distinct life history strategies and to disease.

Assoc. Prof. Andrew Brown: Balancing cholesterol / Cholesterol and cancer

An imbalance of cholesterol in certain cell types plays a role in several diseases. Therefore, knowing precisely how cells regulate their cholesterol levels is central to understanding the development of these diseases, and to identify new possible treatments. The statin class of drugs, worth >$40 billion a year, have been effective in treating heart disease but are not without their side effects. Statins inhibit a very early step in cholesterol synthesis. This research investigates the regulation of novel control points later in cholesterol synthesis, which have been largely overlooked.
Cells need cholesterol to grow and proliferate, while cancer is a consequence of unrestrained cell growth and proliferation. We have shown that that there are fundamental links between cholesterol and cancer. In this work, we use molecular cell biological techniques to further explore this link in the setting of prostate cancer.

Prof Rick Cavicchioli: Environmental Microbial Genomics, Extremophiles and Global Ecosystem Health

The Cavicchioli group examines Microbial Adaptation at the level of cellular responses, evolution and the impact of microorganisms on whole environment ecosystems. Study sites include Antarctica, the Southern Ocean and Heard Island. In addition to the fundamental aspects of biology, we perform applied research, such as the use of enzymes for improved cleaning of membrane filters used in the water industry.

Prof Merlin Crossley: Obesity, blood cell development, cancer and stem cells

My lab studies the role of transcription factors in development and disease. We are investigating how transcription factors control the differentiation of stem cells into various lineages, including blood and fat cells. We aim to understand how the breakdown of these processes leads to diseases, such as diabetes, thalassaemia and cancer. We are also interested in how we might use transcription factors to reprogram cells to treat these diseases.

Dr Anne Galea: DNA-damaging anti-tumour agents

Within my research group, studies into the drug-DNA interactions of various anti-cancer drugs - including bleomycin, cisplatin and various cisplatin analogues - are being conducted. Our group is looking at the direct interaction of such drugs with telomeric DNA and other sequence elements within the human genome. New studies are planned to incorporate

Illumina Next-Generation genome-wide DNA sequencing and gene expression analysis techniques. The main aim of this work is to further elucidate the mechanism of action of these drugs so that more effective cancer chemotherapeutic agents may be developed.

Dr Megan Lenardon: Fungal disease - novel therapies and diagnostics

There is an urgent clinical need for the development of diagnostics and new therapeutics for fungal diseases which research in my group aims to address in innovative ways. We study the biosynthesis of the cell wall of *Candida albicans*, the most common serious fungal pathogen of humans, and are developing antibodies which recognise components of the fungal cell surface for use as diagnostic and therapeutic agents with utility against fungal infections. We are also investigating the interactions between the microbiota (bacteria) and mycobiota (fungi) in the human gastro-intestinal tract, and the molecular mechanisms by which *C. albicans* colonises the colon.

Dr Mike Manefield: Bioremediation and Biogassification

Bioremediation is defined as the use of organisms to facilitate the degradation of pollutants in the environment. In our research we develop bacterial cultures that can degrade common pollutants in groundwater such as chloroform, perchloroethene and 1,2-dichloroethane. We are working with industry partners on high profile contaminated sites in Sydney and Melbourne to assist them in understanding the microbiology of pollutant degradation and in the development of biological technologies for site remediation. Our research has laboratory and field based components.

Biogassification describes the natural process by which microbes degrade coal to produce methane. In this work we are developing a biological technology using native microorganisms to accelerate the underground conversion of coal to methane. Approximately 90% of Australia's famous coal resources are uneconomical to access using traditional mining technologies. A technology that converts coal to methane could generate an energy supply worth an estimated $80 billion and foster the development of an energy industry currently in its infancy with associated employment opportunities. Additionally, methane is a cleaner burning fuel than coal, requires much less water for processing and can generate the same quantity of electricity with lower carbon dioxide emissions. Australia's microbial diversity is a resource we cannot afford to ignore. Our research has laboratory and field based components.

Assoc. Prof. Vincent Murray: Anti-tumour drugs

Cisplatin is a widely used anti-tumour drug. It is the purpose of this research to clarify the molecular events that are important in the anti-cancer activity of cisplatin. In particular we wish to examine the precise genomic sequences that are targeted by cisplatin. Bleomycin is also widely used as an anti-tumour agent. We have recently found that bleomycin interacts strongly with telomeres and we wish to extend these studies. Telomeres are found at the ends of chromosomes and are involved in ageing and cancer progression.

Assoc. Prof. H. Rob Yang: Cholesterol transport, fat storage and obesity

Intracellular cholesterol transport and neurological disorders: We study the cell biology of cholesterol, a molecular that is of important relevance to human health. In particular, we would like to understand the transport of cholesterol within mammalian cells. A number of neurological diseases are caused by cholesterol accumulation in the "wrong" cellular compartments. **Fat storage in eukaryotic cells and obesity:** Fat is stored in eukaryotic cells in the form of lipid droplets. We study the dynamics of lipid droplets, including its size, movement and biogenesis. Results from our study should lead to a better understanding of the cause and progress of human obesity.

School of Biological, Earth and Environmental Sciences

www.bees.unsw.edu.au

School Contact

Assoc. Prof. William Cornwell
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Dr Gab Abramowitz: Climate, ecological and hydrological model evaluation - what defines a good natural system model?

For details of the research area see
http://web.science.unsw.edu.au/~gabrielabramowitz/UNSW_homepage/Gab_Abramowitz_home_page.html

Prof. Andy Baker: Groundwater, cave science, paleoclimate

My group has diverse research interests which focus on using cave stalagmites to reconstruct past climate and environmental change; the question "groundwater organic carbon: source or sink?" and computation modelling of cave and karst processes. For further details, see:
https://research.unsw.edu.au/people/professor-andy-baker

Assoc. Prof. Russell Bonduriansky: Evolutionary Biology

Evolutionary biology seeks to answer the "why" questions in biology: Why are organisms (including ourselves) the way they are? Why do they change over generations? My group investigates the evolution of genetic systems, the role of sexual selection and conflict in evolution, and the implications of environmental effects on trait expression within and across generations. For further details, see http://www.bonduriansky.net/index.htm.

Assoc. Prof. David Cohen: Soil Geochemistry - Mineral Deposits and Contamination

Detection of buried mineral deposits using regional to local scale mapping of soil geochemistry in various places around the globe - Cyprus, PNG, Australia and South America.

Assoc. Prof. Will Cornwell: Plant Ecology and Evolution

Studies the ecology of plants across the world and how they affect the carbon cycle. For more information see http://www.willcornwell.org

Assoc. Prof. Darren Curnoe: Human and Primate Evolution and Pleistocene Archaelogy

For details see http://www.evolution-anthropology.net/

Dr Suhelen Egan: Marine Microbial Ecology and Symbioses

Our research focuses on understanding host-microbe interactions in the marine environment. Projects include a) Deciphering the mechanism of microbial disease progression in marine macroalgae. b) Discovery of novel bioactive compounds from marine host-associated bacteria. C) Investigating the ecological roles of antibiotic producing bacteria. For more information see: https://research.unsw.edu.au/people/dr-suhelen-egan

Assoc. Prof. Jason Evans: Regional climate change, climate processes and modelling

How does the climate of a region, including its water cycle, work? How will a regions climate change due to global warming? or land-use changes? and what impact will these changes have on other natural and man-made systems? How can we best model these systems? What are the regional climate change implications for bushfires? or the Snowy Mountains? or urban air quality? For more information see http://web.science.unsw.edu.au/~jasone/research.html

Dr. Dan Falster: Evolutionary biologist and ecologist

How do competitive interactions shape the ecology, population dynamics, and traits of species and communities? See http://danielfalster.com/

Prof. Emma Johnston: Marine Biological Invasions and Estuarine Health

For details of the research area see http://www.bees.unsw.edu.au/staff/emma-johnston

Dr Michael Kasumovic

We research the evolution of mating systems and how individuals maximize fitness in a variable environment. One aspect of our research focuses how changes in the intensity of male competition and female choice affect the traits that maximize fitness. You can find more information at www.michaelkasumovic.com

Dr. Laurie Menviel: Climate-Carbon cycle interactions

I combine numerical experiments and paleoproxy records to study climate-carbon cycle interactions on millennial to glacial timescales. I am particularly interested in the impact of oceanic circulation changes on the climate and the marine carbon cycle.
For details of the research area, see: http://myweb.science.unsw.edu.au/~lauriemenviel/

Dr Scott Mooney: Using the past (climate, people, fire) for contemporary environmental management

For details of the research area see http://www.bees.unsw.edu.au/staff/scott-mooney

Assoc. Prof. Alistair Poore: Marine ecology and evolution

My research is focussed on the ecology and evolution of marine organisms with a focus on the impacts of herbivores on plant communities, the effects of disturbance on coastal ecosystems, and adaptation to environmental stresses. For more information, see:
http://www.eerc.com.au/alistair_poore/home.html

Dr. Lisa Schwanz: Understanding how animals deal with environmental variation

My group focuses on the impact of the environment on animal behaviour, reproduction, physiology and offspring traits to understand the evolutionary explanations behind plastic traits and the ecological consequences in a changing world. For more details, see lisaschwanz.weebly.com

Associate Professor Wendy Shaw.

Human and interface Geographies, Human and Animal interactions (with Taronga Conservation Society), Various People-based survey and ethnographic research based in Papua New Guinea. For more see: http://www.bees.unsw.edu.au/wendy-shaw

Prof. Bill Sherwin: Molecular Ecology and Conservation Biology

We investigate appropriate ways of monitoring and managing genetic biodiversity. Our study species include dolphins, penguins, trees, plus harvested species such as prawns, and pests such as Queensland Fruit Flies and Macadamia Lacebugs. Our methods range through field studies, genomics and other molecular analyses, demographic and genetic modelling. The latter includes ussing information theory to better track genetic information, in collaboration with mathematicians and physicists. We also investigate the genetic determinants of social behaviour in wild populations, with a current focus on dolphins.

Prof. Steve Sherwood: Applying physics of the atmosphere to clouds and climate.

Research areas see http://www.ccrc.unsw.edu.au/staff/profiles/sherwood/research.html

Dr Paul Spence: Understanding geophysical fluid dynamics and the Oceans role in past and future climate change

For details of the research area see http://web.science.unsw.edu.au/~paulspence/

Prof. Iain Suthers: Marine ecosystems and oceanography

We examine marine ecosystems – from phytoplankton to fisheries – in estuaries and in the East Australian Current (www.FAMER.unsw.edu.au). Particular opportunities include the Sydney Institute of Marine Science (www.sims.org.au), the Integrated Marine Observing System (www.imos.org.au), and especially our recent and future voyages on Australia's brand new, 94 m long, Research Vessel Investigator. Many recent deployments of designed, offshore artificial reefs are in fact experiments relating biological oceanography with recreational fisheries, on an increasingly urbanised coast.

Assoc Prof. Torsten Thomas: Marine Holobionts

It is now increasingly recognised that eukaryotes ranging from humans to plants to invertebrates are not individual organisms, but are in fact complex communities comprised of the eukaryotic host and their associated microbial communities – that is, they are holobionts. We combine ecological and molecular approaches to gain insight into both positive (e.g. healthy development of the host) and negative aspects (e.g. disease) of holobionts in a range of marine systems. For further information see: http://www.cmb.unsw.edu.au/

Dr John Triantafilis: Digital Soil Mapping

For details of the research area see http://www.terragis.bees.unsw.edu.au/

Prof. Martin van Kranendonk

I am involved in research on the early history of the Earth, how the crust of the Earth formed and how life flourished in evolving habitats. I am also engaged in tracking the rise of atmospheric oxygen on Earth around 2.5 billion years ago and how the biosphere responded to these changes. As co-director of the Australian Centre of Astrobiology, I oversee research on the evolution of life and the search for life on other planets. As chair of the Precambrian Subcommission of the International Commission of Stratigraphy, I am responsible for recalibrating the geological time scale over 4 billion years of Earth.

Dr Adriana Vergés: Marine ecology in tropical-temperate transition zones

For details of the research area see http://www.bees.unsw.edu.au/staff/adriana-verges

School of Chemistry

www.chemistry.unsw.edu.au

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Dr Jon Beves: Supramolecular chemistry and molecular devices

Our research is focused on using weak, intermolecular interactions to direct the controlled assembly of group of molecules - just as Nature uses to control all the chemistry of life. By careful design transition metal ions are combined with organic ligands to synthesize large (= nanometre!) ordered structures via spontaneous self-assembly. These novel structures are capable of functions ranging from molecular sensing and catalysis, to performing molecular level work and acting as molecular machines.

Assoc. Prof. Steve Colbran: Transition metal chemistry and catalysis

We use biomimcry to discover new catalysts for multi-electron reduction processes, such as the energy-efficient conversion of carbon dioxide to methanol, a clean alternative transport(able) fuel. For details, see: https://research.unsw.edu.au/people/associate-professor-steve-colbran and http://www.chemistry.unsw.edu.au/staff/stephen-colbran

Dr Alex Donald: Novel methodologies in mass spectrometry

Mass spectrometry is a core enabling technology that is used in many emerging and existing scientific fields for characterizing the components of complex mixtures, including the contents of cells. We are developing and applying experimental methods in mass spectrometry with an emphasis on problems in catalysis, biology, and other areas. Current focus is directed towards performing significant portions of the mass spectrometry experiment in the open laboratory in order to develop energy efficient methodologies for desalinating seawater, separating solvents, and accelerating chemical reactions. We are looking for students who are interested in developing a valuable mass spectrometry skill set.

Prof. Justin Gooding: Nanomedicine

Our research falls under the category of nanotechnology and specifically nanomedicine. Nanomedicine is believed to be the next frontier in medicine where nanoparticles are used as either diagnostic devices or vehicles for delivering drugs directly where need. We work on both these aspects of nanomedicine. As members of the Australian Centre for NanoMedicine, which is based at UNSW, we collaborate with researchers in both medicine and engineering as well as science. In particular we focus on how to give the nanoparticles the functionality that is required via using very well define surface chemistry and we study the fates of these particles in biological fluids and in cells. In essence we are seeking to answer the big question, how do we design nanoparticles that go where we when in a biological system, when we want and give us the information we want?
For details of the research area see
http://www.chem.unsw.edu.au/staffprofiles/gooding.html

Assoc. Prof. Jason Harper: Mechanistic and Physical Organic Chemistry

Our research falls broadly into the category of physical organic chemistry. However, the areas covered also include biological, bioorganic, synthetic, analytical and environmental chemistry and this demonstrates the range of areas that physical organic chemistry is applicable to. The breadth of topics also illustrates the interdisciplinary nature of the research and the significant scope for collaboration with groups in the more traditional areas of organic chemistry and biochemistry. We particularly focus on understanding organic processes in ionic liquids, determining reaction mechanisms and developing novel ways to follow reaction progress.
For more details see area see http://www.chem.unsw.edu.au/staffprofiles/harper.html

Dr Luke Hunter: Fluorine in Organic Chemistry

Fluorine is a small element that packs a big punch. When fluorine atoms are incorporated into organic molecules, they can have a dramatic impact on the substances' physical and chemical properties. In the Hunter group, we are particularly interested in using fluorine atoms to control molecular conformation (a kind of "molecular origami"). We produce novel bioactive molecules that are constrained into optimal 3D shapes, controlled by the precise positioning of fluorine atoms. These shape-controlled molecules are designed to have applications in the treatment of cancer, malaria, and disorders of the central nervous system.

Prof Scott Kable: Laser Chemistry and Spectroscopy

In my group we use lasers to initiate chemical reactions and laser-based spectroscopic methods to probe what happens. In broad terms, we discover new molecules this way, and undercover new pathways that molecules use to evolve from reactant to product. Topics that we are currently investigating include: i) identifying new pathways that lead to acid formation in the atmosphere; ii) discovering new radicals that play a role in combustion of fuels; iii) discovering new chemical mechanisms that violate existing theories of the chemical transition state. New projects are starting all the time. See my web page for a description of projects and some recent publications.

Prof. Naresh Kumar: Design and synthesis of Novel Antimicrobial Agents

Bacterial infections are a growing problem in today's society. With the emergence of multi-drug resistance in common human pathogens, there is clearly an urgent need to develop novel classes of antimicrobials for the prevention and treatment of bacterial infection. It is now well established that bacteria communicate with each other via small diffusible signalling molecules and coordinate their activities such as biofilm formation, swarming and expression of virulence factors in a coordinated manner. Our research focuses on designing and synthesising novel antimicrobial agents that target the bacterial communication system. As well as developing strategies to deliver or generate coatings based on these novel molecules.

Dr Adam Martin: Self-assembly at the neural interface

Alzheimer's and other neurodegenerative diseases are a growing problem in Australia, with over half a million Australian's expected to suffer from dementia in 2025. Our work is concerned with creating better synthetic models of brain tissue and the neural environment. To do this, we use hydrogels to mimic the extracellular matrix of the brain and investigate how changes in these materials alter neural growth, with a view towards identifying biomarkers that play a key role in the early stages of neurodegeneration. For more information, visit http://www.chemistry.unsw.edu.au/staff/adam-martin.

Assoc. Prof. Shelli McAlpine: Medicinal Chemistry

There is a pressing need for new medically significant cancer drugs. Our lab has discovered a molecule that targets a clinically relevant protein, heat shock protein 90 (Hsp90), which uniquely modulates the activity of this oncogenic protein. Our recent discovery has led to a new class of Hsp90 regulators. Utilizing these novel inhibitors as tools allows us to explore how this cancer protein stimulates cancer cell growth. Through synthesis of natural products and analogs, combined with biological mechanistic assays we optimize the natural products as potential preclinical cancer drugs.

Assoc. Prof. Jonathan Morris: Organic and Medicinal Chemistry

Assoc. Prof. Morris's research interests are focused on the development of natural products as biomedical agents. Natural products deliver novel leads for pharmaceuticals in a diverse array of therapeutic areas and offer an excellent starting point for medicinal chemistry programs. One of the bottlenecks in the development of natural products is the availability of the compound. A/Prof Morris's research programme is focused on developing strategies to prepare these valuable materials and generate analogs that have improved potency and selectivity. The group collaborates with medical research groups in the Lowy Cancer Centre, as well as ones based overseas.

Dr Neeraj Sharma: Solid State Chemistry and Energy Materials

Our research looks at how we can make better devices for the energy sector by understanding and manipulating the atomic-scale arrangements (crystal structure) of the materials within these devices. For example, lithium-ion batteries are found in high-power portable electronic devices, but they struggle to provide more than a few hours of stored power for applications such as laptops and mobile phones. Furthermore, these batteries do not provide economically viable energy storage for emerging applications such as electric vehicles. Our research investigates materials that can overcome the storage limitations in these batteries, and develops new battery chemistries that can outclass lithium-ion technology.

Prof. Martina Stenzel: Polymer chemistry and nanomedicine

The delivery of drugs can be improved by packaging the drug into nanoparticles. Nanoparticles for drug delivery have typically sizes below 100 nm and can be prepared using various materials including polymers. In our group, we synthesize various polymers to create core-shell nanoparticles – the core holds the drug, mainly anti-cancer drugs, while the shell makes the particles soluble and determines the interaction with cells. We use a range of materials starting from synthetic polymers, which we combine with nature's building block such as polysaccharides, sugars, peptides and proteins to create hydrid particles. These particles are then loaded with various anti-cancer drugs. Our projects range from the delivery of metal-based drugs such as cisplatin to peptide drugs or DNA.

Assoc. Prof. Pall Thordarson: Functional molecular machines and smart gels

Our work is concerned with using the latest advances in chemistry to create smart materials and devices for tomorrow's challenges. This includes creating novel light-driven molecular machines and materials for clean energy production and the use of self-assembly to create smart gels for applications in medicine including drug delivery and tissue engineering. Both topics are underpinned by our desire to understand how molecules interact with each other in complex chemical systems. For details of the research area see http://www.chem.unsw.edu.au/research/groups/thordarson/ .

Dr Chuan Zhao: Clean Energy and Bionics

Clean, renewable energy has enormous implications for the future prosperity of humankind. As creatures, living better and longer has been our instinctive pursuit, and advanced biomedical technology is therefore always highly demanded. Electron transfer is one of the most fundamental processes in the energy and life systems. Research in our lab addresses problems in clean energy and the life sciences by using electrochemical technology, nanotechnology and biotechnology. Our research areas include solar water splitting, batteries, bionics, biosensors and drug delivery. For more details see http://www.chem.unsw.edu.au/research/groups/zhao/ .

School of Materials Science and Engineering

www.materials.unsw.edu.au

School Contact
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Prof. Veena Sahajwalla: Innovative Recycling of Waste Materials as Resources

The Sahajwalla group is interested in new methods and procedures that will result in cleaner processes used in the resource and mineral industry. As the director of the SMART centre (www.smart.unsw.edu.au) Prof. Sahajwalla leads a dedicated team of scientists and students committed towards a greener and cleaner future. Particular emphasis is placed on industry partnerships. Achieving sustainability targets set by industry has created a need for commercially relevant and globally significant R&D. The SMaRT Centre works with industry partners to develop the fundamental and applied science underlying sustainable materials and technologies.

Assoc. Prof. Nagarajan Valanoor: Physics of nanostructured functional oxides

In my group we investigate the relationship between nanoscale form and function of oxide materials with very small dimensions. Effects ranging from piezoelectricity to photochemical effects to quantum confinement are of interest. We make these materials using a host of ultra-high and high-vacuum epitaxy techniques and study them using advanced probes such as Scanning Probe Microscopy, Transmission Electron Microscopy and in-situ phase mapping. Students are trained on platforms similar to those used in industries engaged in functional materials and electronics. Our work is published in a number of high-level journals such as Nature Materials, ACS Nano, Nano Letters etc.

School of Medical Sciences, Faculty of Medicine

Research is at the heart of the mission of the School, and we are proud of our long history of excellence across the broad sweep of biomedical research disciplines. As a central element of the biomedical research precinct at UNSW, our School features modern laboratory facilities and leading-edge research infrastructure. Our staff and students use their disciplinary expertise in molecular and cellular biology, experimental physiology, pharmacology and tissue pathology to explore the causes and treatment of a wide range of diseases important to our community. They have a strong commitment to assisting the next generation of biomedical researchers gain expertise through higher degree studies, and are supported in their work by an integrated team of research support staff. Many of our researchers are recognised internationally as leaders in their field of research, and we have strong links with colleagues within UNSW, as well as leading research groups both nationally and internationally.

http://medicalsciences.med.unsw.edu.au

School Contact

Dr Trevor Lewis
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Prof Peter Gunning, Prof Edna Hardeman and Dr Nicole Bryce: Targeting the structure of the cancer cell

We are generating new drugs to target the internal structure of both childhood and adult cancer cells. As cancer develops, the malignant cells change their architecture and recruit internal structures to drive increasing malignancy including cell proliferation and migration. We use genetic manipulation and advanced microscopy to identify the key proteins in the structure of cancer cells. This has led to the discovery of multiple new target proteins for the treatment of cancer. Both in silico drug design and chemical library screening have been used to generate new classes of drugs which target different proteins in the structure of the cancer cells. We continue to develop new drugs and test their efficacy and at the same time use the drugs to understand the how cancer cells use these internal structures to mediate their proliferation and spread through the body.

A/Prof Thomas Fath: Neurodegeneration and Repair

The Neurodegeneration and Repair Unit is studying the role of cell architecture components in the regulation of neuronal processes that are important during development, nerve regeneration after injury and in the pathology of neurodegenerative diseases. In particular, the lab is interested in understanding the regulatory role of the actin cytoskeleton in neurite outgrowth and the disruption of the actin cytoskeleton in Alzheimer's Disease pathology. The laboratory is using a wide range of experimental models including cell culture systems and genetically modified mice and cutting edge microscopy techniques to analyse the mechanisms that are involved in these processes.

Dr Angela Finch: Drug discovery with G-protein coupled receptors

Research in the G-protein coupled receptor (GPCR) laboratory encompasses several aspects of the drug design and development process including target validation in disease states (including, prostate cancer, neuroblastoma and preterm birth), screening of new compounds and elucidation of the molecular mechanism of drug binding and receptor activation. The targets which are the major focus of the laboratory are Family A GPCRs, specifically the biogenic amine receptors (α and β adrenoceptors, serotonin receptor 5-HT1A, dopamine D2 & D3 receptors) and the complement 5a receptor. The two questions all the projects within the laboratory address are: (i) Can we develop subtype selective drugs with fewer side effects? (ii) What structural changes occur when a GPCR activates and how do drugs modulate these changes? An exciting new area of research, which her laboratory is undertaking is a drug discovery program looking for novel allosteric modulators of GPCRs.

Prof Lars Ittner and Dr Yazi Ke: Dementia Research Unit

Alzheimer's disease (AD) and related forms of dementia (e.g. frontotemporal dementia) affect over 230,000 people in Australia, with numbers expected to grow to 730,000 by 2050. AD is characterized by progressive loss of synapses and neurons, resulting in brain atrophy and dementia, and eventually death. Unfortunately, there is no cure available and current therapies only achieve symptomatic relief. The Dementia Research Unit (DRU) runs multiple research programs at the forefront of neurodegenerative research using a wide range of cutting edge techniques. Research programs aim to identify pathomechanisms in neurodegeneration using both current and novel transgenic mouse models of disease, as well as develop new approaches for future drug treatment strategies by identifying the underlying drivers of disease progression. The DRU has a total of 6 postdoctoral/senior research fellows, 8 PhD students, 3 research assistants and 3 honours/ILP students. Our research programs are continuously funded by governmental organisations like ARC and NHMRC as well as foundations like Alzheimer's Australia, Motor Neurone Disease Australia, Alzheimer's Association (USA) etc.

Nicole Jones: Neuropharmacology and brain injury

My main research interest is to try and find new drugs to treat acute brain injuries (such as a stroke of birth trauma). We try firstly to understand what happens to brain cells in response to injury and then used various approaches to try and minimise brain injury. Drugs with protective potential are routinely investigated in cell lines, brain tissue cultures and in vivo rat injury models as part of a search for new therapeutic strategies for acute brain injuries. Because tissue hypoxia often occurs after a brain insult, we are interested in learning how hypoxia-inducible proteins (hypoxia-inducible factor-1 (HIF-1), erythropoietin, vascular endothelial growth factor, glucose transporters) are involved in injury and repair processes of the brain.

Dr Trevor Lewis: Structure and function of ligand-gated ion channels.

Ligand-gated ion channels are one of the fundamental building blocks for a functioning nervous system. They are responsible for the fast transmission of signals between nerve cells at specialised junctions called synapses. Research is undertaken on the human glycine receptor as a model system of ligand-gated channels in general. The overall aim is to relate the functional characteristics of the glycine receptor to what is known about its protein structure. We use a combination of patch-clamp electrophysiology recordings and molecular modelling to understand how such a small molecule as glycine can activate the glycine receptor and open the ion channel pore.

Dr Andrew Moorhouse:

Brain function is mediated by an amazing diversity of electrical and chemical signals constantly being communicated across the millions of cells and billions of synaptic connections that comprise this wonderful and complex organ. Our lab group is interested in the cellular and molecular basis of these electrical and chemical signals, and how it is altered in brain diseases such as epilepsy. We use an array of cutting-edge techniques to measure these electrical signals: ranging from the tiny currents that pass the ion channels and receptors in single nerve cells, through to population synaptic responses in isolated slices of brain tissue and finally recording brain activity in vivo using chronically implanted electrodes. Our aim is to elucidate the physiological mechanisms by which various brain proteins work together to generate neuronal signals and how the functions of these proteins change in disease states. Ultimately our research will lay foundations to enable new drugs and improved strategies to better treat disorders such as pain, epilepsy and stroke.

Dr Ingvars Birznieks: Sensory neuroscience

Our senses define our existence and determine how we perceive the world in which we live. I have always been fascinated by the function of sensory organs and astonished by the versatility of clever solutions we see in nature around us. There are many things to discover – not just to increase our understanding how the brain works, but to help people who have lost part of their sensory function due to illness or trauma. We can also borrow ideas from nature and use them to develop future technologies like robotic hands and hand prosthesis which can feel.

Dr Senthil Arumugam: Imaging cell biology in action - fast and fluorescent.

Much like a city, a single living cell has a certain organisation amidst chaos. Analogous to trains and tracks, buses and tracks, a living cell has motor proteins (kinesins, dynein) pulling cargoes (typically in membranous organelles) on cytoskeletal elements (microtubules, actin). Various cargoes – useful to the cell (growth factors, nutrients etc.) and dangerous to the cell (e.g. viruses, toxins etc.) make use of these transport elements to traverse the intracellular milieu. Our lab uses a novel technology based on non-diffracting light sheets to image these fast transport phenomena in the 3-dimensional volume of the cell using fluorescence. Merging basic molecular biology, imaging, automated analysis and visualization including virtual reality technologies, mathematical modelling, we aim to understand the principles of cellular organization that overcome the chaotic crowded environment and result in a living cell.

Dr Jason Potas: Somatosensory systems neuroscience

Humans have a sophisticated somatosensory system (system of body sensors) which performs a variety of tasks that we take for granted. It provides feedback that enables fine motor control, and connects our brains to the outside world by providing us with the capacity to explore our environment as well as enjoy a physical connection with others. While there have been recent outstanding advancements in motor prosthetics which can read brain signals and translate these into complex movement of a robotic arm, the loss of somatosenation limits the success of these motor prostheses. We are yet to work out how to close the loop with sensory feedback to inform the brain of the position and textural experiences that drive our motor system to react appropriately. The focus of our research is to "close the loop" on sensorimotor control. We use a combination of electrophysiology, signal processing and machine learning in small animal models to discover how sensory information is coded in different parts of the central nervous system. We are looking at certain brain regions for the potential to replaced lost sensory information with electrical inputs from a prosthetic device (neuroprosthesis).
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Dr Julian Berengut and Prof. Victor Flambaum: Tests of Grand Unification Theories

Our research interests span many fields of theoretical physics, including problems in atomic, nuclear, and elementary particle physics, gravitational physics, astrophysics and cosmology. Our recent work includes tests of Grand Unification theories (which seek to combine all forces of Nature into one theory), explaining the origin of matter in the Universe (baryogenesis), Big Bang nucleosynthesis, searching for Dark Matter, quantum mechanics in black holes, and designing new superprecise atomic and nuclear clocks.
As a particular example, part of our research is about testing whether the fundamental constants of nature change over space and time. Essentially this asks the question: "are the laws of physics the same everywhere and always?" A measurement of variations in these constants will provide important insights into the deepest questions of physics and cosmology, such as whether there are extra dimensions beyond our three, the nature of dark energy, and whether string theory is correct. Our group, along with John Webb's astrophysics group at UNSW, have reported indications of a spatial variation in the "fine-structure constant" based on measurements of quasar absorption spectra. This work combines several disciplines: spectroscopy, theoretical atomic physics, and astronomy. If proved correct, this result will revolutionise our understanding of the Universe.

Assoc. Prof. Adam Micolich: Nanoelectronics

Our interests are focused on the development of the next-generation of electronic devices that will take us beyond the Silicon microchip era that characterized the late 20th century. Our current focus is on the electronic properties of semiconductor nanowires and devices made from them. In contrast to traditional devices made by etching and depositing metal on flat semiconductor wafers, nanowires grow as microscopic semiconductor towers, 50 nm wide and several microns long, which we then work on turning into devices. For more details, see http://www.phys.unsw.edu.au/nanoelectronics/

Dr Peter Reece: Optical tweezers and laser spectroscopy

Using just light we may catch, hold, manipulate and interrogate objects with dimensions of less than 100 nm. Such nano-scale objects are of great interest for a broad range of applications from nano-electronics to nano-medicine; as well as being great for studying fundamental physics. This is just one of the many laser spectroscopy experiments being conducted in the Optoelectronics Research Laboratory in the School of Physics.

Prof. Chris Tinney: Astrobiology and Extrasolar Planets

My group's research is centred on the detection and study of very small and very cool things - exoplanets and brown dwarfs - using a variety of observing techniques, including "Doppler Wobble" searches for planets orbiting Sun-like stars and sub-giants, direct imaging of long-period companion systems with NICI on Gemini, "Direct" detection searches for planetary-mass members of nearby star clusters, and searches for the coldest brown dwarfs in large sky surveys. The search for extrasolar planets, and the understanding of the habitability of those planets, is a key component of the global, multi-disciplinary astrobiology initiative. Our group is a key component of the Australian Centre for Astrobiology here at UNSW.

Prof. Joe Wolfe: Musical Acoustics

Prof Wolfe and his lab team study the acoustics of the voice, the ear and musical instruments. Despite its familiarity, the basic physics of the voice is not well understood, because of the ethical and practical limitations on doing the obvious physics-style experiments and because there is no appropriate animal model. We often study singers, in part because sustained vowels at a given frequency offers experimental advantages and because some subtle features are more important. Musical instruments are better understood, but the importance to musicians of quite subtle effects means that there are many research questions still to answer. Much of our research involves the player-instrument interaction, including the acoustics of the vocal tracts of wind instrument players. Because our research is of interest to music teachers, students and performers, we maintain large lay-language web-sites to explain aspects our work to those audiences. For more information see http://www.phys.unsw.edu.au/music/

School of Psychology

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Dr Lenny Vartanian: Body dissatisfaction, weight stigma and eating behavior

My work generally focuses on the psychology of eating and weight, and particular areas of interest include body dissatisfaction, dieting and eating behaviours, and obesity stigma.

Body image concerns are increasingly prevalent among women and men. One of the key predictors of body dissatisfaction is the extent to which individuals internalise societal standards of attractiveness (thinness for women, and muscularity for men). I am interested in identifying factors that predict who is likely to internalise the societal standards of attractiveness, as well as determining whether those factors can be modified as a means of reducing or preventing body dissatisfaction.

Negative attitudes towards obese people are widespread, and obese people experience discrimination in virtually every aspect of their lives. Weight-based discrimination is associated with a range of negative consequences for the stigmatised individuals. Research in this domain will focus both on developing a better understanding of what underlies people's negative attitudes towards obese individuals, and on examining the impact that weight-based discrimination has on obese individuals.

Unhealthy eating is a key public health issue, particularly because it can contribute to poor nutrition and weight gain. Although people's food intake is in part driven by how hungry they are and by how much they like the food they are eating, there are other powerful influences on the amount of food that people eat. These include social factors (*e.g.*, what other people are eating) and environmental factors (*e.g.*, how much food is available), which might influence people's food intake without their awareness. Research in this area will examine to what extent people are aware of the social and environmental influences on their food intake, and whether they can be made aware of these influences as a means of helping them improve their eating habits.

Prof Colin Clifford: Vision

The primary research focus of my laboratory is vision, how context affects our perception, and how our visual awareness might be related to the underlying neural processing. Potential projects include:

1) **Gaze Perception:** To an observer, the direction of your gaze reveals where you are looking and hence what you are looking at. This might be an object of shared attention or it might be the observer him or herself. The direction of your gaze is thus a strong social signal to your intentions and future actions. This project aims to understand the processes in our brains that enable us to know where someone else is looking. **Suggested reading**: Mareschal, I., Calder, A.J. & Clifford, C.W.G. (2013). Humans have an expectation that gaze is directed towards them. *Current Biology* **23**, 717-721.

2) **Visual Feature Binding:** The seeing part of the brain, visual cortex, can be subdivided into many regions. Breaking down vision like this leads to a problem. If different attributes of the visual scene are dealt with in different parts of visual cortex, how is it that we experience the world as coherently as we do? The question of how distributed neural processing gives rise to a unified perceptual representation of the world is often termed The Binding Problem. This project will explore the limits of perceptual binding in human vision. **Suggested reading:** Clifford, C.W.G. (2010). Dynamics of visual feature binding. In *Space & Time in Perception & Action*, R. Nijhawan & B. Khurana (eds.), Cambridge University Press, pp.199-215.

3) **The Role of Spatial and Temporal Context in Perception:** Vision is a dynamic process with adaptation as a fundamental property. Our visual systems are continually recalibrating themselves to the prevailing visual environment. Considering visual processing as an adaptive system in this way emphasizes that coding depends on context, and thus an understanding of contextual modulation is central to an understanding of visual coding. How any given region of an image is perceived depends strongly on the spatial and temporal context in which that region is presented. Spatial context is the structure of the surrounding image, while temporal context is represented implicitly in the adapted state of the observer's visual system. This project aims to use contextual manipulations to understand the coding of information in the human visual system.**Suggested reading:** Clifford, C.W.G. & Rhodes, G. (eds.) (2005). Fitting the Mind to the World: Adaptation and Aftereffects in High-Level Vision. Oxford: Oxford University Press.

A/Prof Tom Denson: social-personality

1) Why do men and boys LOVE violent video games so much? We have proposed the 'dominance-practice hypothesis' which is that males are attracted to violent video games because they allow players to practice displays of dominance and aggression. We are interested in examining preferences for violent video game play in response to two classic primate competitive situations: mating competition and physical strength competitions between males.

2) Angry rumination in groups as a determinant of intergroup aggression.

3) Reducing aggression by practicing self-control and cognitive training.

A list of all of my papers can be found at: http://www.psychexperiment.net/denson/pubs. Many were co-authored by former students.

Dr Chris Donkin: human cognition

See www2.psy.unsw.edu.au/Users/CDonkin.

1) **Memory:** The ability to store and retrieve information using memory is one of our most remarkable qualities. Some general questions worth pursuing might be: Is the capacity of short-term memory constrained to be a fixed number of whole items, or do we distribute a mnemonic resource amongst items? How does the potential for rehearsal influence access to short-term memory? Do verbal and visual short-term memory systems differ in fundamental ways?

2) **Decision:** People behave differently depending on whether you ask them to respond quickly or respond accurately. The most common explanation is that people simply collect more evidence before responding when asked to be more careful. An alternative idea I would like to explore is whether people simply guess more often when asked to go fast.

3) A Crisis of Confidence in Psychology: The reliability of a number of important results in psychology has recently been called into question. The problem arises because of a number of "dodgy" but common research practices. For example, no distinction is made between exploratory or confirmatory experiments (i.e., whether the researcher has outlined hypotheses, predictions, and analysis techniques before doing an experiment), evidence for a null hypothesis is impossible to accrue using standard statistics, and while conceptual replications are common, true replication is not.

Prof Brett Hayes: "high level" cognitive processes

1) How many types of reasoning are there? Psychological theories of human reasoning generally distinguish between deductive and inductive reasoning. Roughly speaking, deduction involves determining whether an inference necessarily follows from a given set of information (e.g., if we know that "All university students have high IQs" then it necessarily follows that "Psychology students have high IQs"). Induction on the other hand, involves assessing the plausibility of an inference (e.g., if we know that "Psychology students have high IQs" then it might seem plausible but by no means certain that other university students have this property). Recently, some researchers have challenged the "dual-process" account of reasoning, suggesting that both induction and deduction can be explained by a common set of psychological processes. This project examines single-process and dual-process models of reasoning using innovative techniques for comparing induction and deduction. There is also scope for projects examining the development of each form of reasoning. **Suggested Reading**: Heit, E., & Rotello, C. (2010). Relations between inductive reasoning and deductive reasoning, *Journal of Experimental Psychology: Learning, Memory, and Cognition, 36*, 805-812.

2) The role of causal knowledge in intuitive probability judgments: People are often faced with situations that require intuitive judgments of probability (e.g., how far can I trust this person? how likely is it that my headaches are a sign of a serious illness?). This project examines how we can improve the accuracy of people's intuitive probability judgments by providing them with information about the causal mechanisms that that give rise to observed probabilities (e.g., different causal mechanisms that could lead to headaches). **Suggested Reading**: Krynski, T., & Tenenbaum, J. (2007). The role of causality in judgment under uncertainty. *Journal of Experimental Psychology: General, 136, 430-450.*

3) "As if thinking" in reasoning and judgment This project examines how people reason and make decisions about situations involving category uncertainty. For example a doctor may see patient with symptoms that are consistent with more than one diagnosis. In such situations optimal reasoning and decision-making involves taking into account all of the uncertain alternatives (other possible but less likely diagnoses). A wealth of evidence however, shows that when people make predictions about an uncertain situation they usually focus on just one likely alternative (e.g., the most likely diagnosis) and ignore other alternatives that are relevant to their prediction. This is a phenomenon we have termed "as if thinking". This project will involve designing experiments that specify the conditions under which people engage in as-if thinking and how this reasoning bias might be overcome. **Suggested reading**: Hayes, B. K. & Newell, B. R. (2009). Induction with uncertain categories: When do people consider the category alternatives? *Memory and Cognition, 37*, 730-743.

Prof Simon Killcross

1) Mechanisms of habit learning: Previous research indicates that, with continued training, lever pressing in rats makes a transition from being goal-directed (that is, influenced by the contingency between the instrumental response and reward, and the value of that outcome) to being habitual (whereby the response appears to be independent of current contingency and reward value). Disruptions of this transition process are thought to be, in part, contributors to drug addiction, and disorders of cognitive control such obsessive compulsive disorder and Tourette's syndrome. The proposed project will examine the psychological and neurochemical processes that dictate this transition. Nelson A & Killcross AS (2006) Amphetamine exposure enhances habit formation. Journal of Neuroscience, 26, 3805-3812.

2) Control of behavioural flexibility by the prefrontal cortex: A number of lines of evidence suggest that different subregions of the medial prefrontal cortex (mPFC) in the rat subserve distinct but complementary cognitive functions that attempt to achieve a trade-off between the control of behaviour by prior experience and the need to adapt to novel situations in a changing world. More formally, we have suggested that the prelimbic region of the mPFC acts to bring both simple cue-outcome associations and more complex behavioural patterns under the modulatory influence of contextual or other task relevant information; by contrast, the infralimbic mPFC exerts an inhibitory influence over the prelimbic region, biasing animals towards simple, prepotent or innate behavioural patterns. This project will examine tests of this hypothesis using a variety of behavioural procedures designed to assess the role of modulatory information in governing task performance. Rhodes SEV and Killcross AS (2007) Lesions of rat infralimbic cortex enhance renewal of extinguished appetitive Pavlovian responding. *European Journal of Neuroscience*, 25(8), 2498-2503.

3) The role of behavioural chains in goal-directed action: When animals produce an instrumental response for food, they do not produce a discrete action that leads to the immediate ingestion of food, but rather initiate a sequence of closely linked behaviours that ultimately result in the delivery of food. At a minimum, this chain might be leverpress -> magazine entry -> consumption. A variety of theorists have suggested that the nature of behavioural control that is present at different points in this chain varies as a function of, for example, proximity to final reward. This project will examine the development of such chains over the course of training and will attempt to establish the role of behavioural chains in performance and sensitivity to outcome value. Balleine, Bernard W.; Garner, Claire; Gonzalez, Felisa; Dickinson, Anthony (1995) Motivational control of heterogeneous instrumental chains. *Journal of Experimental Psychology: Animal Behavior Processes*, 21(3), 203-217.

Prof Gavan McNally: Behavioural and brain mechanisms for learning and motivation

1) Defining and manipulating the brain circuits for relapse and extinction of drug seeking

Relapse to drug-taking is the fundamental problem facing any treatment of drug addiction. 70-80% of drug-users seeking treatment will relapse to drug taking within 12 months of treatment. This project studies the neural and behavioural mechanisms for relapse to drug taking using animal models of cocaine addiction, methamphetamine addiction, and alcoholism. It also studies the brain mechanisms for extinction of drug seeking and attempts to use this knowledge to identify new ways of treating human drug users. **Suggested reading:** Millan, E.Z., Marchant, N.J., & McNally G.P. (2011). .Extinction of drug seeking. *Behavioural Brain Research*, **217**, 454-462. Conklin, C.A., & Tiffany, S.T. (2002). Applying extinction research and theory to cue-exposure addiction treatments. *Addiction*, 97, 155-67.

2) Defining and manipulating the brain circuits for prediction error in Pavlovian conditioning: Pavlovian fear conditioning has served as a useful model for studying the brain mechanisms of learning. Contemporary neural models characterise Pavlovian conditioning as detecting CS-US contiguity. By contrast, contemporary psychological models characterise Pavlovian conditioning, at least in part, as the learning of predictive relations. In other words, neuroscientists have largely failed to incorporate a role for the learning of predictive relations in their analyses of the brain mechanisms for fear conditioning. This project studies the brain mechanisms for predictive learning in Pavlovian fear conditioning, using optogenetic and pharmcogenomic control over defined cell populations in specific neural circuits. **Suggested reading**: *McNally, G.P., Johansen, J., & Blair, H.T. (2011).* Placing prediction into the fear circuit. *Trends in Neurosciences, 34, 283 - 292.*

3) Erasing drug memories: One of the more startling claims from contemporary research into the brain mechanisms for memory is that individual specific memories can be targeted and erased via simple behavioural manipulations. This project studies this process in an animal model of drug addiction. Drug associated cures exert a powerful control over craving and relapse to drug seeking. The project studies whether the memories of these cues can be erased and hence no longer drive drug seeking. **Suggested reading**: Xue, Y.X. et al. (2011). A memory retrieval-extinction procedure to prevent drug craving and relapse. *Science, 336,* 241-245.

A/Prof Dr Joel Pearson: New methods to map the human brain

1) The neural dynamics and treatment of visual hallucinations: Using novel techniques to figure out what causes visual hallucinations and how to control them eg. Developing new treatments. Utilising controllable visual hallucinations to study consciousness in the normal population.

2) Fighting mental disorders with Mental Imagery: Many mental disorders are associated with uncontrollable mental imagery. We are working with new cutting-edge methods to measure the sensory strength of mental imagery and developing new methods to control its strength and vividness. We aim to reduce the strength of mental images as a symptom, but when imagery is used in treatments such as in cognitive behavioural therapy it is advantageous to have stronger and more vivid mental imagery.

3) Mapping the Human brain: Work on exciting cross-disciplinary projects focusing on innovative new ways to map the human brain using combinations of different neural imaging and modeling approaches. These cross-disciplinary projects will be loosely between the fields of neuroscience and mathematics/engineering/computer science or physics. Ranging from fundamental mechanistic work to applied clinical applications. For these projects students need to have a basis in Engineering, Physics, Maths, and Computer Science or a related field, and fluency in at least one computer programming language.

4) Decision-making: The study of decision-making spans such varied fields as neuroscience, psychology, economics, statistics, political science, and computer science. Despite this diversity of applications, most decisions share common elements including deliberation and commitment to an outcome. The lab is currently investigating how information outside of conscious awareness can change the decisions you make.

5) Does Intuition actually exist? (The scientific study of intuition): To answer this question, we utilise conservative, objective and reliable neuroscience techniques (i.e. noisy visual decisions) to study and even ask the question does intuition actually exist. We have ongoing projects using **novel empirical paradigms, physiological measures and computational decision models to show that unconscious emotional information can boost accuracy in concurrent emotion-free decision tasks**. Emotional signals, that subjects are never aware of, can be utilized to boost performance in simultaneous, non-emotional decisions. **These data and techniques show for the first time that 'intuition' does indeed exist, different unconscious emotions can boost concurrent non-emotional behaviour – a process of intuition**.

Dr Jenny Richmond: Developmental Psychology

1) I like that one better: Advertisers use evaluative conditioning to shift our preferences for products. For example, Nespresso manufacturers know that by pairing their product with George Clooney some of the positive feelings toward the actor will rub off on the product and we will like the product better than if they paired it with an unattractive/unliked actor. Recent work in our lab has shown that much like adults, infants' preferences for initially neutral objects can also be shifted by pairing them with either positively-valenced or negatively-valenced stimuli. In this study we used an evaluative conditioning paradigm, pairing one object with happy facial expressions and another object with angry facial expressions and recording where babies were looking during conditioning using an eye tracker. When infants were given the choice between the two objects, most chose the object that had been paired with the happy face. This behavioural preference depended on the pattern of looking behaviour exhibited during conditioning. Infants who did not show a "face preference" during learning did not pick the positively-valenced stimulus at test. We are currently following up on this study to see whether this evaluative conditioning effect generalises to other affective stimuli (i.e. mums face vs. stranger face) and testing whether the face preference is a causal mechanism in this kind of learning.

2) Back to the future: Episodic memory allows us recollect past events, however, we can also draw on experience to imagine how future events might play out (Schacter & Addis, 2007). Recent work in our lab has focussed on exploring how the ability to imagine future events develops during childhood. We have recently shown that the ability to talk about future events is related to relational memory abilities (Richmond & Pan, 2013) and that the ability to make behavioural choices for the future is related to executive function. But do narrative and behavioural tasks tap the same kind of future thinking abilities? Is the ability to talk about future events related to the ability to make choices for the future? Our current work is testing this question in 3- to 5-year olds.

3) I know how you feel: Young infants very quickly become experts in processing faces; with relatively little experience they learn to discriminate between faces of different people and different emotional states. With experience, children learn to read how other people are feeling and understand others emotional states. These processes are impaired in autism spectrum disorders (ASD) and cause major issues in social functioning. Work in our lab uses EMG technology to measure the tiny changes in facial muscles that are produced when we see others express emotion. Current projects are looking at how these low-level affective reactions are related to empathy development and the kinds of social responsiveness abilities that are impaired in ASD during the preschool period.

For more details about the research areas of other staff in the School of Psychology please see the descriptions of the School's research expertise at
http://www.psy.unsw.edu.au/research