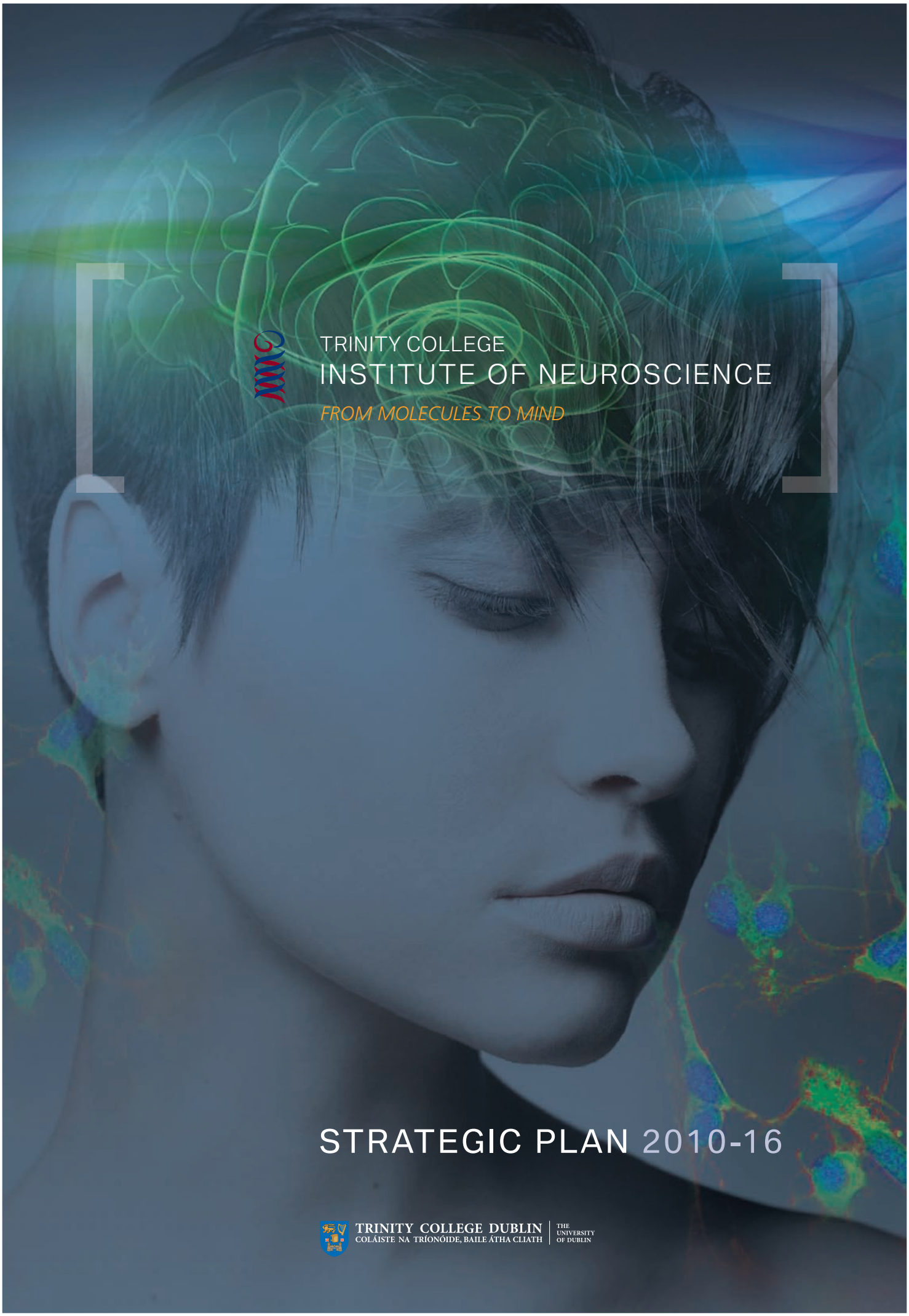
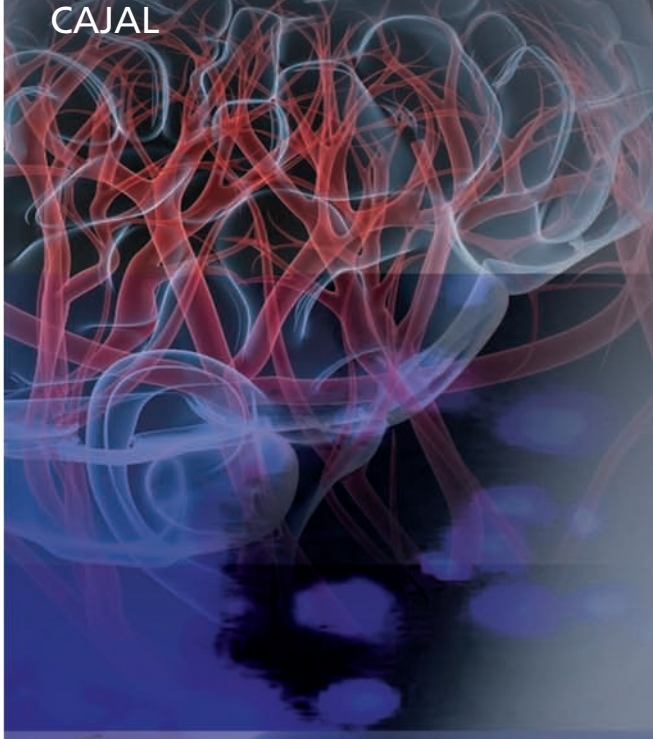

TRINITY COLLEGE
INSTITUTE OF NEUROSCIENCE
FROM MOLECULES TO MIND
STRATEGIC PLAN 2010-16
TRINITY COLLEGE DUBLIN
COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH
THE UNIVERSITY OF DUBLIN


"TO KNOW THE BRAIN...IS EQUIVALENT TO ASCERTAINING THE MATERIAL COURSE OF THOUGHT AND WILL, TO DISCOVERING THE INTIMATE HISTORY OF LIFE IN ITS PERPETUAL DUEL WITH EXTERNAL FORCES."
CAJAL

CONTENTS

"THE BRAIN IS A WORLD CONSISTING OF A NUMBER OF UNEXPLORED CONTINENTS AND GREAT STRETCHES OF UNKNOWN TERRITORY."

CAJAL



'Shane O'Mara's research focuses on the relations between cognition, synaptic plasticity and behaviour, in the context of brain aging and depression.' (shane.omara@tcd.ie; shane.omara@gmail.com)

'Ian Robertson's research focuses on identifying and remediating cognitive impairment in aging and other conditions using novel combinations of behavioural, brain stimulation and pharmacological therapies.' (ian.robertson@tcd.ie)

'Thomas Connor's research is focused on the role of inflammation in the neurodegenerative process, and in the development of drugs for psychiatric disorders including depression and anxiety' (connort@tcd.ie)

'Declan McLoughlin's research focus is developing molecular biomarkers to aid diagnosis and long term management of depression in parallel with randomised controlled trials to improve therapy.' (d.mcloughlin@tcd.ie)

'Andrew Harkin's research, in the area of neuropharmacology, is focused on the neurobiology of depression, the development of novel antidepressants and the adverse effects of drugs of abuse.' (aharkin@tcd.ie)

'Ruth Byrne's research examines cognitive processes in human reasoning and imaginative thought.'(ruth.byrne@tcd.ie)

'Kumlesh Dev investigates molecular mechanisms regulating receptor trafficking to develop novel drug targets and therapies for neurodegenerative diseases, with a particular focus on Multiple Sclerosis.' (kdev@tcd.ie)

'Áine Kelly's research group investigates neuroprotective strategies that may prevent cognitive impairments associated with the aging process.' (aikelly@tcd.ie)

'Richard Reilly's research is focused on signal processing for new neurodiagnostics, neural prostheses and therapeutic neuromodulation devices.'(richard.reilly@tcd.ie)

'In a simple, defined neural circuit, Mani Ramaswami's group studies in vivo mechanisms of implicit, inhibitory learning of relevance to autism and schizophrenia.' (mani.ramaswami@tcd.ie)

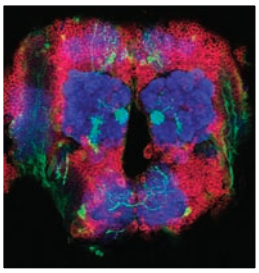
'Alice Witney's research analyses how different sources of sensory input alter movement control to adapt to changing environmental and task demands.' (awitney@tcd.ie)

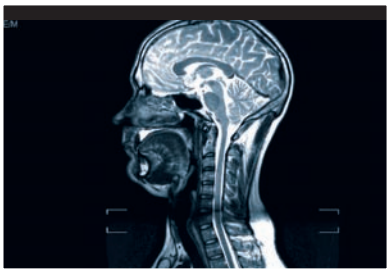
'Daniela Tropea investigates the neurobiology of neurodevelopmental disorders combining molecular, anatomical and physiological approaches.' (tropead@tcd.ie)

'Christian Kerskens is interested in the physical basis of physiology. He focuses on transport and diffusion processes.' (christian.kerskens@tcd.ie)

WHY EXPLORE THE BRAIN?

Drosophila brain
(J. Hillebrand/
TCIN Images)





Human brain
MRI Study.
(S. Joseph/
TCIN Images)

Understanding the structure and functions of our brains brings us a good way along the path of understanding ourselves as humans; progress in understanding the nervous system materially benefits human health, welfare and knowledge.

TCIN'S MISSION

The Trinity College Institute of Neuroscience (TCIN) leads brain research in Ireland and is the country's only dedicated neuroscience research institute. TCIN has led the growth of Trinity College Dublin's and Ireland's strong international reputation in neuroscience to become one of Europe's leading research institutes.

Research in TCIN is captured in the following phrase:

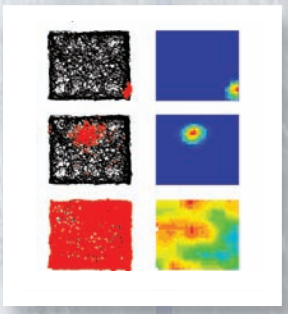
'Understanding the brain from molecules to mind'

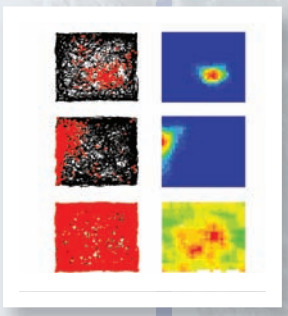
Our mission echoes that of Trinity College itself:

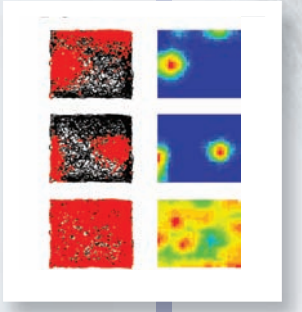
Through our research and teaching in neuroscience, we engage students and society in the quest for knowledge about the human brain and mind, and seek to achieve excellence in all we do. We respond with creativity and imagination to the challenges and opportunities of a shared future, by developing and applying our fundamental scientific knowledge for the benefit of human health, welfare, and knowledge.

TCIN has a full range of modern technologies and facilities that allow it to realise its *'molecules to mind'* research mission. TCIN hosts approximately 45 Principal Investigators (professors and lecturers from various disciplines within Trinity College) and their research groups (postdoctoral researchers and Ph.D. students), as well as technical and managerial support staff.

TRANSFORMATIVE NEUROSCIENCE







Spatial location of neuronal activity study (S. O'Mara / TCIN images)

Neuroscience has a uniquely transformative potential as a science in modern society. It impacts on public policy in a wide range of areas, from education to healthcare, from the legal system, to bioethical issues. Two examples illustrate the broad potential impact of neuroscience research:

- *Diseases of the brain account for about 35% of the overall disease burden of the European Union,* costing about €400 billion per year. These costs will increase dramatically as the population of the EU ages. Delaying the onset and attenuating the disease burden would enhance individual quality of life and reduce the strain on the healthcare systems of the EU.

- *Neuroscience promises transformative effects on education,* as the importance of critical developmental periods and of appropriate environmental enrichment to maximise human potential become understood.

The mind and brain sciences reach into every aspect of human behaviour. The discoveries made in TCIN inform undergraduate and postgraduate education, drive changes in industry and clinical practice, and allow us to lead international research collaborations. This dynamic is driven directly by the generation and transmission of new knowledge with a human impact and human consequence.

CONTEXT

As we celebrate the 10th anniversary of the inception of the Trinity College Institute of Neuroscience and the 5th anniversary of our accommodation in the Lloyd Building, we renew our shared vision of a world-class neuroscience research institute in this strategic plan to drive our development for the coming six years.

Neuroscience is a headline strategic priority for further sustained development within Trinity College's own strategic plan. TCIN's strategic plan is the outcome of discussions participated in by all of the collaborators in TCIN. We have developed a shared vision of what a world-class neuroscience research institute can achieve, and we have developed a plan to make that vision a reality.

Our goal is to ensure that TCIN continues to make new discoveries advancing our understanding of the structure and the function of the brain in health and in disease. We pledge that the excellence of our original research and the significance of our novel discoveries will continue to build TCIN's international reputation for cutting-edge research. We commit to continuing to make a distinctive contribution to human health and welfare, leading the innovative exploration of new areas of neuroscience, facilitated by our focus on translational 'bench to bedside' research.

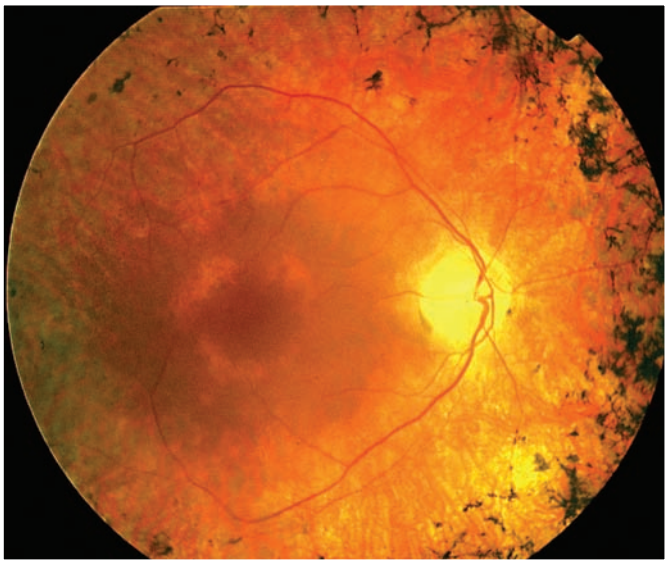
TRINITY COLLEGE INSTITUTE OF NEUROSCIENCE TODAY

TCIN is an interdisciplinary research institute with Principal Investigators from a wide range of disciplines including psychology, physiology, biochemistry, engineering, psychiatry and genetics, among others. Given our diverse disciplinary origins, it is no surprise that interdisciplinarity is at the core of our research effort. The Institute currently comprises some 45 academic and clinician-scientist Principal Investigators (PIs) and their research groups to a staff complement of approximately 250 researchers. TCIN is formally recognised as a Trinity Research Institute (TRI), and neuroscience is identified within Trinity College's Strategic plan (2009-2014) as a primary research strength within Trinity College.

TCIN is housed in the Lloyd Building on the Trinity College campus. TCIN possesses advanced research technologies in-house, including two high-field Magnetic Resonance Imaging (MRI) systems, preclinical models, access to patient populations, biosamples, and genotyping. It holds current substantial research funds from diverse sources, including Science Foundation Ireland, the Wellcome Trust, the Health Research Board, the European Commission Framework Programme and industrial sponsors, as well as substantial philanthropic support. TCIN has received significant past support from the Higher Education Authority Programme for Research in Third-Level Institutions in Ireland (PRTLI-Cycle 3) which provided the priming grant to construct TCIN in 2001. TCIN engages in significant innovation initiatives with large-scale industrial sponsors (such as GlaxoSmithKline, Intel, GE and others).

TCIN PI's have produced over 450 scientific publications in the past 3 years in world-class peer-reviewed international journals. Its scientific articles have placed the Institute in the top 0.01% of neuroscience institutes in the world by citations (ISI Thomson Reuters, 2009).

TCIN currently has over 80 registered Ph.D. students engaged in advanced research. In addition, it educates 18 postgraduate students annually, who graduate with an M.Sc. in Neuroscience (the only one in Ireland). It also educates 42 undergraduate students each year who graduate with a B.A. (Mod.) in Neuroscience. It hosts a popular public lecture series annually, and it has initiated and participated in major exhibitions in Trinity College's Science Gallery.



Ocular Study
P. Kenna / TCIN Images

Our animating ethos rests on the belief that major and fundamental research problems are best solved by combining research strengths *across disciplines* and *levels of analysis*. Combining our strengths in this way will allow us to deliver major scientific discoveries of great consequence for human health, welfare and knowledge.

Over the next five years we plan to build on our existing strengths within the following three thematic research areas:

- **Research Focus 1:** *Synapses, Cognition and Behaviour*
- **Research Focus 2:** *Neuropsychiatry and Neurodevelopmental Disorders*
- **Research Focus 3:** *Neurodegeneration, Neuroprotection and Neurorepair*

and we plan to further develop our platform technologies:

- **Platform Technologies Focus: Imaging and Neural Engineering.**

Reflecting TCIN's interdisciplinary ethos, our Principal Investigators will align their research activity **across** these thematic areas. By leveraging our **research strengths** in these areas, we plan to prioritise our focus on **innovation**, to continue to develop our successful education programmes and to continue to build our significant **contribution** to society and outreach activities.

‘Arun Bokde’s group investigates how large scale neural networks in the brain support cognitive function and how breakdown in such networks leads to cognitive impairment with particular focus on neurodegeneration.’ (bokdea@tcd.ie)

‘Julie Kelly’s research focuses on investigating the roles of neuropeptides in the central nervous system (CNS) and development of neuropeptide-based therapeutics for CNS disorders.’ (kellyja@tcd.ie)

‘Orla Hardiman's research focuses on clinical, epidemiologic, and complex genetic aspects of neurodegenerative diseases, identifying new therapeutic targets and disease-specific biomarkers, and providing well-phenotyped patient cohorts for early-phase clinical trials.’ (ohard@iol.ie)

‘Connail McCrory's research focuses on the neuronal mechanisms of chronic pain in man and the factors which affect the conversion of acute to chronic pain.’ (dr.mccrory@painclinic.ie)

‘Khurshid Ahmad's research is in computational neuroscience where artificial neural networks are used to study cross-modal behaviour - vision/language; numerosity/language.’ (khurshid.ahmad@cs.tcd.ie)

‘Brian Lawlor's research focuses on improving our understanding of the psychological, social and biological aspects of Alzheimer's disease with a view to developing novel treatment strategies for this neurodegenerative disorder.’ (blawlor@stpatsmail.com)

‘Gavin Davey's research focuses on energy metabolism in the brain and the involvement of mitochondrial dysfunction in the neurodegenerative process.’ (gdavey@tcd.ie)

'Kevin Mitchell's lab focuses on the links between the genetics of brain wiring and neurodevelopmental disorders or conditions, including schizophrenia, autism, epilepsy and synaesthesia.' (kevin.mitchell@tcd.ie)

‘Hugh Garavan researches the neurobiology of cognitive control with a particular interest in individual differences and how they contribute to psychiatric conditions such as addiction.’ (hugh.garavan@tcd.ie)

‘...MAN THINKS AND FEELS BY MEANS OF HIS NERVE CELLS AND ... THE TRUE EXTERNAL WORLD, BEGINS FOR HIM AT THE FRONTIERS OF THE CEREBRAL CONVOLUTIONS’

CAJAL

RESEARCH FOCUS 1: SYNAPSES, COGNITION AND BEHAVIOUR

INTELLECTUAL CONTEXT

The nervous system does not function as an isolated assortment of molecules or neurons; it functions in an integrative manner to give rise to behaviour and experience. The major goal within this thematic area is to discover how it does so. The *Synapses, Cognition and Behaviour* thematic research area focuses on the analysis of the functions of the brain (such as attention, memory, reasoning) with the aim of understanding the brain systems that sustain and underlie specific psychological functions (such as spatial navigation or episodic memory).The empirical focus is on the manipulation and measurement of behavioural or cognitive variables using tools from a wide range of sciences, e.g. biology, genetics, anatomy, physiology, endocrinology, pharmacology, neuropsychology, cognitive psychology, mathematics, and computer science.

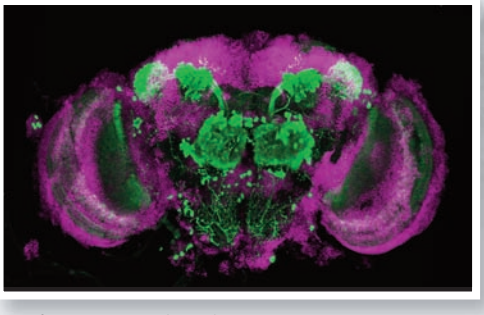
SCIENTIFIC AND SOCIETAL IMPACT

Research in the *Synapses, Cognition and Behaviour* thematic research area addresses a major challenge for contemporary science: to understand the brain's systems and circuits sufficiently to enable cures for neurological conditions associated with age, injury and disease.

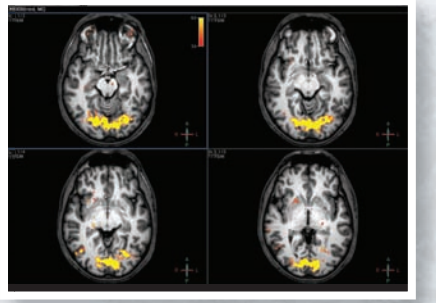
STRATEGIC RESEARCH OBJECTIVES

Research on *Synapses, Cognition and Behaviour* combines core competences in genetic, cellular, mathematical, behavioural and cognitive neuroscience with state-of-the-art engineering to address key questions in neuroscience:

- Understand how neural circuits are built during development and change with experience.
- Investigate sensory, perceptual and cognitive experience and how brain systems encode them.
- Explore the neurocognitive processes that drive human behaviour through functions such as learning, memory and cognition, attention, reasoning and decision making, arousal, motivation, reward, and social interaction.
- Apply this knowledge in a clinical context.
- Develop new non-invasive techniques to analyse brain processes in health and disease, coupled to new data analytic and mathematical methods.
- Explore new models to investigate normal and abnormal brain function and behaviour.
- Investigate neuroplastic compensation mechanisms and how they could be enhanced.



Olfactory Centres (green) in Drosophila brain
J. Hillebrand/TCIN Images



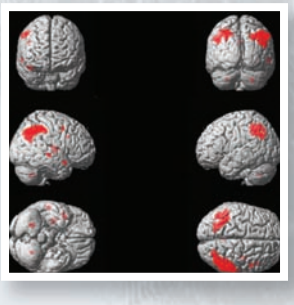
Functional MRI study of the brain.
S. Joseph/TCIN Images

RESEARCH FOCUS 2:
NEUROPSYCHIATRY AND NEURODEVELOPMENTAL DISORDERS

INTELLECTUAL CONTEXT

The *Neuropsychiatry and Neurodevelopmental Disorders* thematic research area addresses neuropsychiatric disorders which are major contributors to the global burden of disease and are thus of significant individual and socioeconomic importance. Research in this thematic area develops a scientific understanding of the basic mechanisms underlying these disorders, and the translation of this knowledge into improving clinical diagnosis and enabling effective treatments. This will be accomplished through the development of synergistic interactions between basic and clinical disciplines and collaboration with clinical and industrial partners.

SCIENTIFIC AND SOCIETAL IMPACT



fMRI study of Cognitive Impairment in the brain
A. Bokde/TCIN Images

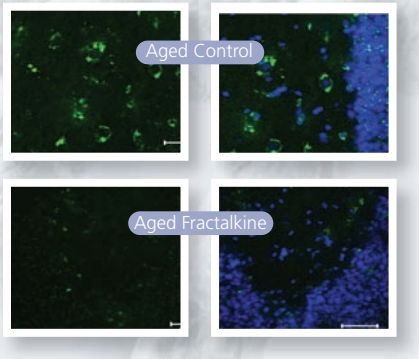
Significant discoveries have been made in the identification of genetic risk factors, disorder pathogenesis, biomarkers, and biopsychosocial interventions to improve patient care and treatment outcome. Further research impacts are identified in a breadth of areas, including neurodevelopmental, child and adolescent disorders; adult psychosis and affective disorders; disorders of brain aging and neurodegeneration; neuroimmunology; and addictions. These impacts necessitate the development of a biobank of biological samples (e.g. DNA, RNA, protein) from well-characterised diagnostic and control groups, the implementation of new physics/imaging methods from preclinical to clinical MRI scanners to maximise the translational value of MRI research by combining electrophysiology as well as structural and functional MRI methods.

STRATEGIC RESEARCH OBJECTIVES

Research on *Neuropsychiatry and Neurodevelopmental Disorders* has several key objectives:

- Improve the health care of persons with neuropsychiatric disorders by engaging in a fully integrated approach linking basic and clinical biomedical research.
- Drive innovation and early-stage research and development in areas of unmet clinical need including diagnostics, therapeutics and strategies targeted at disease prevention.
- Support technology transfer to enable practical applications of research, including drug discovery and development of innovative healthcare products, devices and technologies.
- Foster clinical translation to fast-track the uptake of research advances into clinical practice.
- Facilitate development of new drugs, devices, biomarkers, or other alternative therapeutic strategies and new diagnostic or research techniques.
- Catalyse activity at all stages of translational research to integrate target discovery, experimental preclinical and clinical research.
- Directly bridge the gap between preclinical models and human research, and build on infrastructural innovations and human capital investments.
- Collaborate further with industry to strengthen translational research and to access reagents and other high-throughput facilities.

RESEARCH FOCUS 3:
NEURODEGENERATION, NEUROPROTECTION AND NEUROREPAIR



Microglial activation in the aging brain.
M.A. Lynch/TCIN Images

INTELLECTUAL CONTEXT

Understanding the fundamental mechanisms by which the brain develops and matures, and by which it responds to insult, are central unsolved problems of contemporary neuroscience. The major goals for the *Neurodegeneration, Neuroprotection and Neurorepair* thematic research area are therefore to identify new targets for the prevention and treatment of neurodegenerative diseases, and to engage in translational neuroscience by exploiting findings of preclinical studies for application to clinical disorders.

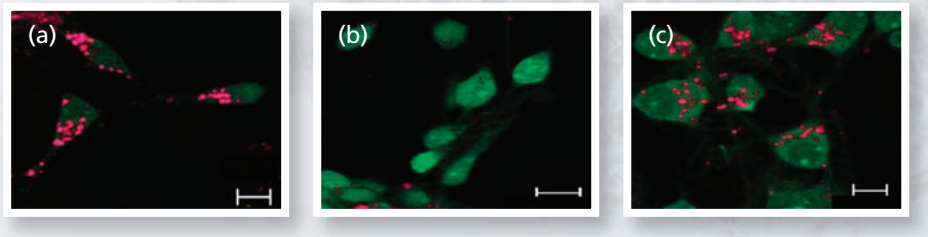
SCIENTIFIC AND SOCIETAL IMPACT

Treatments for neurodegenerative diseases are limited and clinical efficacy is poor. Research in the *Neurodegeneration, Neuroprotection and Neurorepair* thematic area aims to provide a panel of possible new targets, and to provide appropriate preclinical and clinical samples to evaluate the potential of these novel targets.

STRATEGIC RESEARCH OBJECTIVES

Research on *Neurodegeneration, Neuroprotection and Neurorepair* has the following major objectives:

- Understand the molecular mechanisms underlying neurodegenerative changes in the aged brain, and how they apply to dementias, especially Alzheimer's disease and other neurodegenerative conditions.
- Evaluate the contribution of neuroinflammation to the development of neurodegenerative changes and to identify modulatory strategies.
- Identify novel neuroprotective strategies based on analysis of molecular mechanisms.
- Develop novel behavioural and brain stimulation methods that can be integrated with pharmaceutical therapies to delay cognitive decline.
- Identify novel biomarkers of neurodegeneration using our advanced simultaneous functional MRI/electroencephalogram (fMRI/EEG) systems.



Exposure of neurons to cannabinoid. A. Gowran, V. Campbell/TCIN Images

PLATFORM TECHNOLOGIES FOCUS: IMAGING AND NEURAL ENGINEERING

INTELLECTUAL CONTEXT

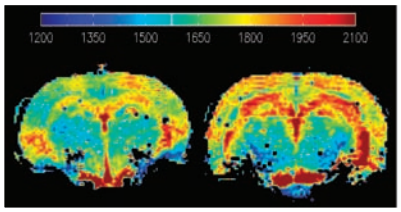
TCIN possesses advanced systems for small-bore preclinical brain imaging, and for human brain imaging. The goal of the *Platform technologies* thematic focus is use neuroimaging tools in a truly integrative, interdisciplinary manner for the detection, real-time monitoring, and diagnostic prediction of physiological and cognitive states, in a way that has not been successfully achieved elsewhere. Brain imaging research is often conducted separately from other research areas such as molecular and cellular neuroscience. TCIN is unique in bringing these different research strands together in the same building, and aims to build on unique synergies in neural engineering, including neurodiagnostics, neural prostheses, neuromodulation devices and therapeutic electrical stimulation.

SCIENTIFIC AND SOCIETAL IMPACT

Advances in platform technologies lead to the development of specific neurodiagnostic systems of real clinical benefit for the study of aging, as well as neurological and psychiatric disorders; to the development of new methods for neurodiagnostics, neural prostheses, neuromodulation devices and therapeutic electrical stimulation; and to the development of methods for harvesting information from signals acquired from excitable tissue.

STRATEGIC RESEARCH OBJECTIVES

Advances in platform technologies have key objectives for *functional neuroimaging, decoding brain activity,* and for *active implantable devices.*



T1 relaxation time is increased in the aging brain.
C. Blaü/TCIN Images

In the area of functional neuroimaging, we will:

- Develop new methods for real-time functional brain imaging.
- Develop new methods to image brain function with the highest spatial and temporal resolution possible, especially in combination with EEG.
- Develop new methods to image the functional and structural connectivity of the brain.

In the area of decoding brain activity, we will:

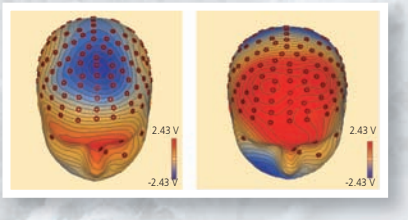
- Improve the ability to decode brain signals across all levels of complexity, i.e. from a single neuron to the whole brain.
- Develop new methods to understand how synaptic activity is integrated to whole brain function.

In the area of active implantable devices, we will:

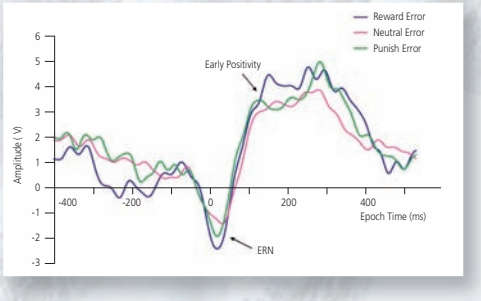
- Develop new methods to functionally interface to neural tissue giving real time information.
- Develop new methods to stimulate and record neural activity with closed loop control.
- Develop new methods to integrate noninvasive external devices with the brain.

Supporting these developments requires the development of a computational infrastructure for curating data which is increasingly captured at higher frequencies and greater levels of resolution. Such a provision will facilitate data audits and data storage for research publication, and make data more freely available for external collaborative analyses.

INNOVATION



Contour map of ERP study of reward & punishment effects on error awareness in a Go/No-Go Task



Graphic of ERP study of reward & punishment effects on error awareness in a Go/No-Go Task R. O'Connell/ TCIN Images

CONTEXT

TCIN, through the excellence and relevance of its research, has engaged in major collaborations with industry partners (such as GlaxoSmithKline, Intel, and GE). Its innovation goals are accomplished through growing existing partnerships and forging new ones with industrial collaborators. The GSK-TCIN collaborative programme has, for example, focused on translational research to accelerate the development of novel therapies for Alzheimer's disease. The Intel-GE-TCIN collaborative programme has focused on the development of technologies to support independent living in old age. These are very substantial programmes involving multiple TCIN Principal Investigators (including clinician-scientists), and provide advanced training and experience for a large cadre of postdoctoral researchers and Ph.D. students. TCIN intends to continue to strengthen such links, and to use our extensive experience with commercial entities to engage in further large-scale, fundamental problem-oriented research. TCIN is very attractive as a collaborator, because the breadth and depth of our focus on translational research enables the acceleration of the development of novel therapies for neurocognitive function.

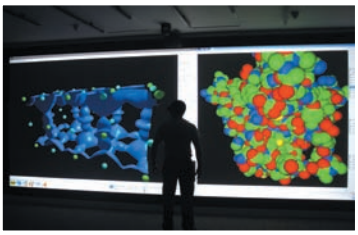
SCIENTIFIC AND SOCIETAL IMPACT

TCIN has a collaborative research capacity among its Principal Investigators which uniquely integrates cognition, behaviour, neurophysiology, biomarkers and imaging in preclinical and clinical models of neurocognitive function in health and disease. TCIN's creation of new knowledge has contributed significantly to Ireland's smart economy, through the conduct of research that is pivotal to the development of new pharmaceutical and other therapies for brain diseases, and also through the education and training of Ph.D. students and post-doctoral researchers suited to a knowledge-led society. Such human capital formation is a significant contribution towards national and global economic recovery.

STRATEGIC INNOVATION OBJECTIVES:

- Play an active part in the Innovation Academy to develop the skills of Ph.D. researchers in neuroscience.
- Establish targets for the commercialisation of soft research services, e.g. to establish a focused contract research service over the next five years.
- Develop at least one spin-out company based on current research discoveries within TCIN over the next five years.

EDUCATION



TCHPC/TCIN Images

The research strengths of the Trinity College Institute of Neuroscience ensure that it is ideally placed to contribute to the education of the new generation of neuroscientists.

Ph.D. by research: TCIN currently has approximately 80 registered Ph.D. students. 65% of these are Irish and 35% are international students. Students get first-hand exposure to state-of-the-art technologies for investigating brain function from molecular and cellular levels to clinical and translational levels. They have the opportunity to work in a dynamic research and training environment with the leading principal investigators in the field. 12 students have graduated from TCIN with a structured Ph.D. in neuroscience. The program, funded by the HRB, was introduced in 2006. About 140 students from around the world applied annually for the 6 places. Students carried out taught modules in neuroscience in their first year, cycled through laboratory rotations of three months duration in their first year, and carried out a major research thesis in their second and third year. The continuation of a structured Ph.D. programme in neuroscience is a major priority for TCIN for the future.

B.A. (Mod.) in Neuroscience: There are currently 42 students carrying out the B.A. in Neuroscience. The program was introduced in 2001 and 160 students have graduated since that time. They enter through the omnibus science options and choose to specialise in neuroscience in their third and fourth years. They complete modules in a wide range of neuroscience topics ranging from cellular physiology to cognitive neuroscience.

M.Sc. in Neuroscience: There are currently 18 students carrying out the M.Sc. in Neuroscience. The program was introduced in 2006 and 53 students have graduated since that time, it provides students with a fundamental understanding of the biological basis of nervous system function and is the first program of its kind in Ireland.

FUTURE EDUCATION OBJECTIVES

- Increase the provision of systematic training in advanced methodologies for Ph.D. students.
- Ensure impact on clinical practice, to address the key problem of how to translate research findings into clinical practice and to create a generation of research-aware clinicians involved in patient care.
- Continue a structured funded Ph.D. program based on the earlier program, to provide a source of world-class Ph.D. students for the research of the future, as well as the fast-evolving needs of industry of the future.
- Increase our capacity to supervise undergraduate, M.Sc. and Ph.D. research projects, through increasing the number of Principal Investigators.
- Build on the international visibility of our educational programmes by further promoting them.
- Increase our links with industry, thereby providing attractive alternative forms of employment for our graduates, through placements and collaborative research programmes.

CONTRIBUTION TO SOCIETY AND OUTREACH

The research strengths of TCIN ensure that it is ideally placed to contribute to society and to the future health and welfare of all individuals. The societal impact of our research themes can be summarised as follows:

Research on *Synapses, Cognition and Behaviour* contributes to understanding the brain sufficiently to enable cures for neurological ailments associated with age, injury and disease.

Research on *Neuropsychiatry and Neurodevelopmental Disorders* contributes to an understanding of neurodevelopmental, child and adolescent disorders; adult psychosis and affective disorders; disorders of brain aging and neurodegeneration; neuroimmunology; and addictions.

Research on *Neurodegeneration, Neuroprotection and Neurorepair* provides possible new therapeutic targets, as well as appropriate clinical samples to evaluate the potential of these novel targets.

Advances in *Platform Technologies Supporting Brain Imaging and Neural Engineering will* lead to the development of specific neurodiagnostic systems of real clinical benefit for the study of aging, neurological and psychiatric disorders, and to the development of new methods for neural prostheses and therapeutic electrical stimulation.

TCIN's outreach activities have ranged from engagement with young children in their views of the brain through a children's art competition, through to the frequent involvement of its principal investigators with relevant public bodies, charities and our frequent engagement with the media. Recent outreach activities include the following:

- TCIN hosts an extramural lecture series - 'The 21st Century Brain'. Topics include *Training the Brain, Breakdown of the brain - Alzheimer's disease,* and *Stem Cells: What use are they in the fight against brain disease?*

- TCIN has initiated and participated in exhibitions at Trinity College Dublin's Science Gallery. For example, *The 'Lab in the Gallery'* and the *'LoveLab'* Exhibitions occurred during 2009/2010 and PIs Ian Robertson, Richard Reilly, and Fiona Newell were co-curators for these exhibitions.

- NEUROSOC, the student neuroscience society promotes interest in all areas of neuroscience through the hosting of academic and social events for the undergraduate and graduate population of TCD.

CONTRIBUTION TO SOCIETY AND OUTREACH

Public policy impacts include service by Principal Investigators on national and international committees that have moderated or determined national and international policy on human stem cells or the applicability of preclinical models to human clinical conditions. Other impacts include the citation of our research work in international legal decisions, the development and usage of novel neurodiagnostic tests and input to clinical treatment guidelines. We will continue to broaden and deepen this involvement in the years ahead.

FUTURE OUTREACH OBJECTIVES

- Build on the initial lecture series.
- Continue exhibitions in the Science Gallery.
- Facilitate and strengthen capacity to affect public policy through our interaction with the media and key stakeholders.
- Broaden and deepen our use of social networking sites, blogging and other media to facilitate debate and knowledge transmission.

FUTURE OPPORTUNITIES

The development of TCIN as a World Intellectual Hub for neuroscience will depend on our response to the major world-wide scientific challenges in neuroscience. We identify the following two key opportunities for TCIN over the next five years:

- *Advance the scientific understanding of the mind and brain in health and disease.*

- *Maximise the health benefits of neuroscience discoveries through translational research.*

TCIN has a unique ability to avail of these core opportunities because of our fundamental, problem-oriented research in our thematic research areas:

- *Synapses, Cognition and Behaviour*
- *Neuropsychiatry and Neurodevelopmental Disorders*
- *Neurodegeneration, Neuroprotection, and Neurorepair*

supported by our platform technologies in:

- *Imaging and Neural Engineering*

We will continue to consolidate our research, teaching and innovation activities into as integrated a physical space as possible, because this will allow us to continue our interdisciplinary research, teaching and innovation mission. We will seek to increase large-scale industrial interactions and be a partner of choice for a diverse portfolio of indigenous and multinational companies. We will implement a monitoring and updating mechanism to measure the effectiveness of the new strategic plan.

MEASURING IMPACT: HARD AND SOFT METRICS

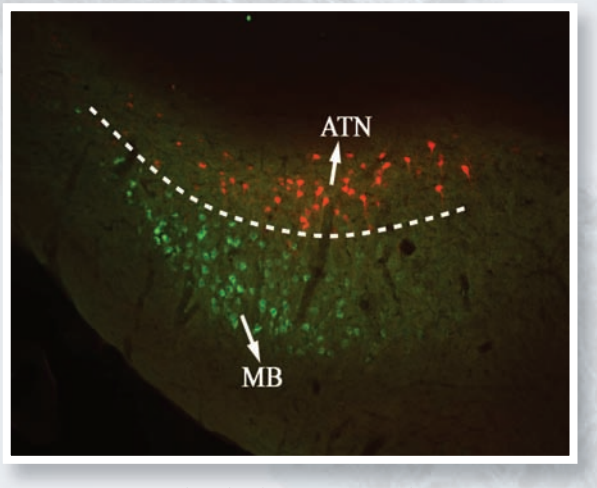
We believe that it is essential that the success of TCIN in achieving its strategic goals over the next five years be measured. The metrics we will rely on are all proxies for the *measurement of academic excellence.* In general terms, the metrics will focus on assaying:

- Scholarly publications
- Research expenditure
- Education
- Contribution to society and outreach
- International visibility and collaboration
- Industrial-Commercial innovation

We will produce an annual 'balance sheet' for these metrics in the TCIN annual report. We will conduct a mid-term external peer review of TCIN.

FINAL THOUGHTS

The guiding principle of our strategic plan is that TCIN continues to provide a unique environment for us to combine research strengths across disciplines and levels of analysis, to make new discoveries that advance human understanding of the structure and the function of the mind and brain in health and in disease, to make a distinctive contribution to human health and welfare, and to lead the innovative exploration of new areas of translational 'bench to bedside' neuroscience. Our strategy promises scientific discovery, scholarly impact, and industrial innovation of great consequence for human health, welfare and knowledge.



Two neuron types in the subiculum: Anatomy study.
S. O'Mara/TCIN Images

‘Paul Dockree’s research focuses on understanding cognitive dysfunction following Traumatic Brain Injury (TBI) and developing new translational methods to improve patient recovery from cognitive disabilities.’ (dockreep@tcd.ie)

‘Colm Cunningham's research addresses the influence of both systemic and CNS inflammation in episodes of delirium and on the progression of chronic neurodegeneration.’ (cunnico@tcd.ie)

‘Aiden Corvin's group work on translating progress in identifying risk genes for schizophrenia and bipolar disorder into novel diagnostics and therapeutics for these disorders.’ (acorvin@tcd.ie)

‘Michael Rowan’s group studies the mechanisms underlying the regulation of synaptic plasticity during learning and in models of stress and Alzheimer’s disease.’ (mrowan@tcd.ie)

Thomas Frodl`s research focuses on functional, microstructural and molecular brain changes in stress-related psychiatric disorders, aging and during psycho- and pharmacotherapy.’ (thomas.frodl@tcd.ie)

‘Colin Doherty’s research interests are translational aspects of epilepsy, dementia, genetics and brain imaging.’ (codohert@tcd.ie)

‘Marina Lynch’s research is designed to examine the impact of aging on synaptic function with an emphasis on understanding the role of microglia.’ (marina.lynch@tcd.ie)

‘Daniel Ulrich’s research focuses on the mechanisms of sleep-induced changes in synaptic transmission at neocortical synapses.’ (ulrichd@tcd.ie)

'Aileen Lynch's research investigates the mechanisms which modulate blood-brain barrier permeability, particularly in the context of the aging brain.' (amlynch@tcd.ie)

‘Rose Anne Kenny's research focuses on the relationship between neurocardiovascular instability and brain aging in the context of syncope, falls and frailty.’ (rkenny@tcd.ie)

‘Pete Humphries research interests are in human molecular and medical genetics, and especially degenerative diseases of the retina. Current research is directed toward the molecular pathologies associated with such conditions, in addition to developing translational molecular therapies involving neuronal barrier modulation technologies for optimizing systemic low molecular weight drug uptake by the retina and brain.’ (pete.humphries@tcd.ie)

'Veronica Campbell's group investigates cellular mechanisms involved in neurodegeneration and neuroprotection.' (vacmpbll@tcd.ie)

‘Juan Pablo Labrador’s research is focused on understanding the epigenetic and transcriptional mechanisms required to program stem cells into neurons.’ (jp.labrador@tcd.ie)

‘The goals of Fiona Newell’s research are to understand how multisensory information is integrated for the coherent perception of objects, persons and places, and to elucidate the brain mechanisms underlying these processes.’ (fiona.newell@tcd.ie)

‘Gary Donohoe’s research focuses on genetic aspects of neurocognitive deficits associated with psychiatric disorders and cognitive remediation for these deficits.’ (donoghug@tcd.ie)

‘Desmond O'Neill’s work focuses on stroke, dementia and ageing: health services, gerontological and cognitive aspects, and sub-topic interests in
a) stroke/neurodegenerative diseases and driving/transport,
b) neuroimaging and cognition in older people.’ (des.oneill@amnch.ie)

THE LARGE BRAIN - LIKE LARGE GOVERNMENT MAY NOT BE ABLE TO DO SIMPLE THINGS IN A SIMPLE WAY

HEBB

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'IT IS IN THE BRAIN THAT EVERYTHING TAKES PLACE.... IT IS IN THE BRAIN THAT THE POPPY IS RED, THAT THE APPLE IS ODOROUS, THAT THE SKYLARK SINGS.'

OSCAR WILDE