



TRINITY COLLEGE
INSTITUTE OF NEUROSCIENCE

FROM MOLECULES TO MIND



TRINITY
COLLEGE
DUBLIN

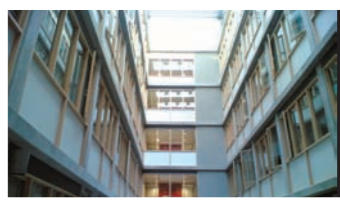


Trinity College Institute of Neuroscience (TCIN)

Trinity College Institute of Neuroscience, TCIN, is an interdisciplinary research institute founded in 2002 in order to advance the frontiers of neuroscience. The institute has built a team of world-class scientists from diverse fields who collaborate in addressing one of the most pressing problems of our time - how to optimise the best functioning of the human brain.

TCIN is based in Trinity College's Lloyd Institute where it operates in over 3,300m² of state-of-the-art research facilities. The institute comprises scientists and clinicians from the disciplines of genetics, physiology, biochemistry, immunology, pharmacology, neurology, psychiatry, gerontology, psychology, engineering and physics, thereby enabling a novel multidisciplinary approach.

The continuing growth and development in neuroscience is driven by: **a** the lack of effective treatments for many neurological and psychiatric diseases and the need for new therapeutic strategies **b** an increase in neurodegenerative diseases in line with the ageing population, and **c** significant economic and societal costs associated with neurological and psychiatric diseases



TCIN is based in the Lloyd Institute

Over 500 disorders affect the nervous system and according to a World Health Organization report published in 2007, neurological disorders ranging from migraines to epilepsy and dementia, affect up to 1 billion people worldwide.

FACT

Mission Statement

The mission of TCIN is: "To advance understanding of brain function in health and disease by capitalising on the diverse expertise of our researchers, promoting scientific excellence, and communicating our research to scientific colleagues, students and the general public."



Molecular modelling of drug action



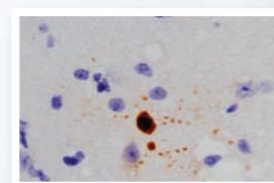
MRI image of the brain

RESEARCH FOCUS

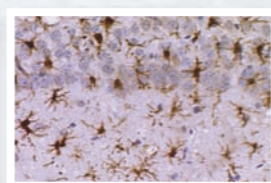
The 5 research themes in TCIN:

1 Neurodegeneration, neuroprotection and neurorepair

Research in this area is focused on understanding the underlying causes of neurodegenerative disorders including Alzheimer's disease, Stroke, Parkinson's disease, motor neuron disease and multiple sclerosis. Understanding the biological basis of these disorders, which is the ultimate aim, will enable scientists to develop interventions to repair the brain and protect it from further degeneration. The role of inflammation and oxidative stress in the deterioration of neuronal function, that is common to several neurodegenerative conditions, is a major focus of investigation.



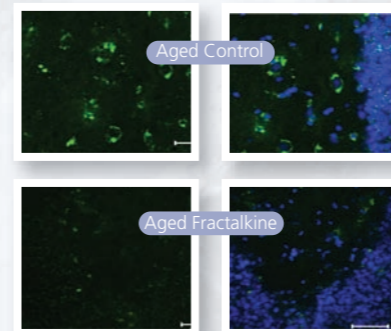
Neuron Degeneration (brown staining)



Microglia - the primary immune cells of the brain (brown staining)

2 Brain aging

TCIN scientists engage with clinicians to study the risk factors and identify markers for diseases of brain ageing. One particular aim is to identify individuals who are at high risk of developing age related neuro degeneration with the ultimate aim of planning and managing disease progression. TCIN has recently discovered new biomarkers which could predict the likelihood of developing Alzheimer's Disease (AD). The ultimate objective is to identify novel approaches to improve the diagnosis and treatment of this and other diseases of brain ageing.



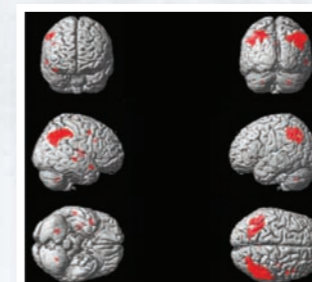
Microglial activation (green staining) is increased in the aging brain. An injection of fractalkine (Blue staining) attenuates this age-related change (less green staining implies less activation).

TCIN investigators are also involved in the TILDA programme, a 10,000-person longitudinal study of aging in Ireland (<http://www.tilda.tcd.ie/>).

3 Learning, memory and cognition

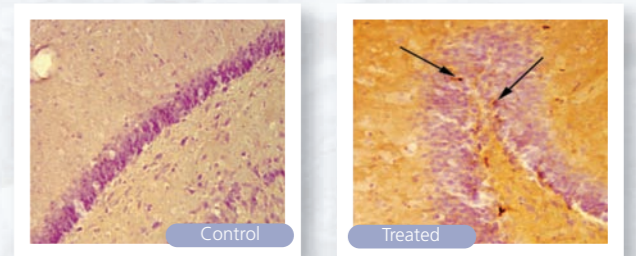
The focus of this research cluster is to investigate the relationships between synaptic plasticity, cognition and changes in learned behaviour. Recent highlights include the establishment of a specialized memory clinic and the development of technologies for independent living in partnership with St. James Hospital and Intel.

Research work utilizes a variety of techniques from formal studies of deductive reasoning and counterfactual imagination, to brain imaging of human cognition and analysis of basic mechanisms using pre-clinical models. There is also a strong research programme on disordered cognition in neurological and neuropsychiatric patients.



Differential fMRI study, the areas marked in red show areas of brain atrophy specific to Mild Cognitive Impairment (MCI)

4 Psychiatric diseases and drug abuse

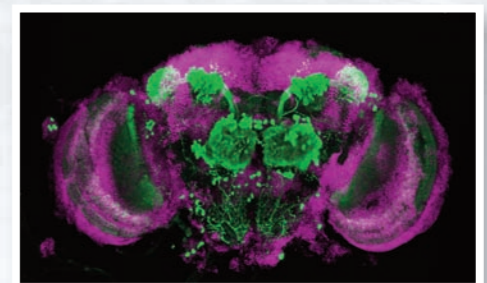


A study showing the antidepressant effect of neurogenesis (brown staining) in the hippocampus.

Research in this area is focused on developing improved models for diseases such as depression in an effort to understand the cellular and molecular mechanisms involved and thereby improve therapies. Our research also aims to develop the understanding of molecular mechanisms of action of drugs of abuse such as cannabis, ecstasy and cocaine. Magnetic Resonance Imaging (MRI) is a key technology in this research where it is used to compare functional brain activity of healthy individuals with those affected by drugs of abuse.

5 Neural development and plasticity

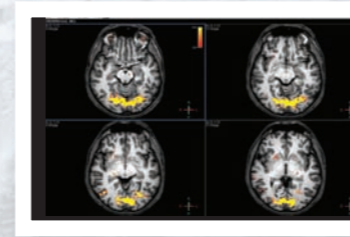
The research groups in this thematic area study the development, function and plasticity of neuronal circuitry that underlies brain function. A key focus is analysis of genetic factors associated with diseases of the brain. One research group probes genetic and cellular mechanisms of synaptic and behavioural plasticity in the relatively simple neural network that drives Drosophila olfactory behaviour. Other researchers study how neuronal circuits yield specific patterns of activity and how these activity patterns influence, and are influenced, by experience or disease.



Olfactory Centres (green) in Drosophila brain

Infrastructure & Technology

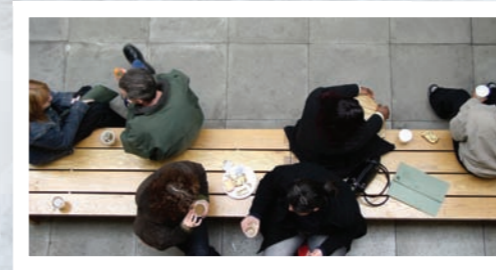
TCIN houses Ireland's first research-dedicated MRI facility, with a whole body 3T MRI scanner and a small-bore 7T MRI scanner in routine use. These high field MRI systems are the tools of choice for understanding brain structure and function. Additionally, individual laboratories maintain an array of equipment for conducting molecular and cellular biology and behavioural tests.



Functional MRI study of brain showing activity during visual cortex task

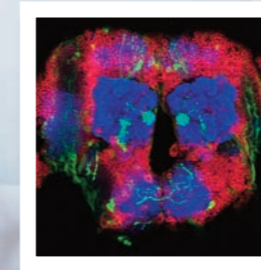
Education & Outreach

TCIN offers educational programmes at undergraduate and postgraduate level, including a BA (Mod), an MSc and a structured PhD in Neuroscience. These degree programmes are highly competitive and attract excellent students from around the world. These educational initiatives position TCIN as a leader in training the next generation of neuroscientists.



Our outreach activities include organisation of events for Brain Awareness Week; developing links with secondary schools by offering transition year placements and hosting teachers as researchers in our laboratories; engaging with the media to educate the public about our research; participating in exhibitions on our research in Trinity College's Science Gallery (www.sciencegallery.com); and hosting national and international symposia and conferences.

Drosophila brain showing genetically marked single neurons in green and synaptic regions in blue.



Industrial partners

TCIN realises the importance of bringing innovations to market and has formed collaborative research programs with several industrial partners. In the technology arena, the Technology Research forIndependent Living (TRIL) programme was formed with Intel, and is one of the largest such programs worldwide. It aims to develop innovative technologies to enable older adults to avoid falls and accidents and live independently for longer (www.trilcentre.org). Our flagship pharmaceutical partnership with GlaxoSmithKline is focused on discovering biomarkers and treatments for Alzheimer's disease. €14.6 million in funding has been committed to this 5-year research programme which utilises the expertise of pre-clinical and clinical researchers in TCIN, NUIG and St. James Hospital.



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