UNIVERSITY OF BIRMINGHAM

RESEARCH THAT MATTERS

CENTRE FOR HUMAN BRAIN HEALTH

The University of Birmingham is leading the way in research into how to help a brain become healthier, and stay healthier, by combining state-of-the-art facilities with high quality academic research.

The Centre for Human Brain Health (CHBH) is an interdisciplinary brain research facility established with the mission of understanding what makes a brain healthy, how to maintain it, and how to prevent and reverse damage. The Centre is home to state-of-the-art brain imaging facilities, which are used to uncover the mechanisms supporting cognition in both the healthy and the dysfunctional brain.

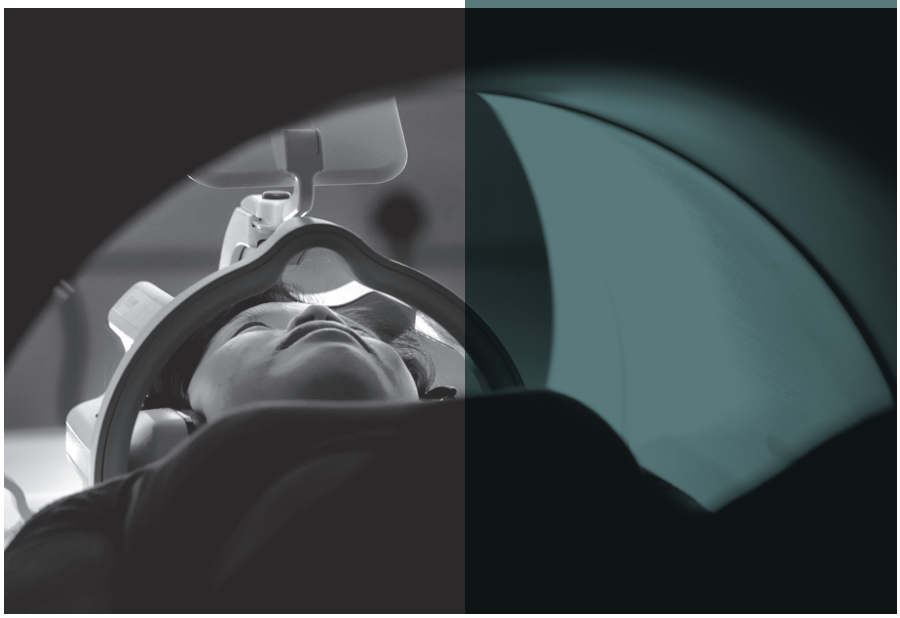
The vision of the CHBH is to cross the boundaries of traditional academic and clinical disciplines to transform our understanding of the human brain. We recognise that to achieve the goal of personalised brain health we must first identify what constitutes a healthy brain, and how lifestyle, developmental, and societal factors interact and contribute to this endeavour.

We use our multidisciplinary expertise and state-of-the-art technology to identify the key factors for maintaining a healthy brain. To do this, we are developing and applying advanced neuroimaging techniques, including the development of new sensor technology, to characterise brain structure and function, combined with experimental and lifestyle interventions to enhance brain health across the lifespan.

Background

- Over recent decades, important insight has been gained into the mechanisms supporting human brain function. This insight has been driven by the development and application of new imaging techniques
- These techniques can identify where and when the brain processes occur that support cognition and behaviour
- The challenge in the years to come is to understand how brain regions interact as a network, both in healthy people and in individuals with psychiatric and neurological problems
- Meeting this challenge requires the application and integration of multiple brain imaging tools

MULTIPLE RELATED FACTORS CAN INFLUENCE THE RESILIENCE OF THE INDIVIDUAL BRAIN – FROM GENETICS, EXERCISE AND GENERAL LIFESTYLE TO NUTRITION, SLEEP HABITS AND ABNORMAL THOUGHT PATTERNS.



CENTRE FOR HUMAN BRAIN HEALTH

www.birmingham.ac.uk

The Approach

The Centre for Human Brain Health will be housed in a new building which is due for completion in 2018. This will enable a productive, collaborative and intellectually rich research environment, supporting investigators from across the University and the wider area to apply state-of-the-art imaging techniques to investigating the brain, including:

- A 3T magnetic resonance imaging (MRI) scanner
- Elekta Neuromag TRIUX magnetoencephalography (MEG) system
- High density electroencephalography (EEG) laboratories
- Two fully equipped sleep laboratories
- Exercise laboratory
- Functional near-infrared spectroscopy (fNIRS) system
- Brain stimulation facilities including transcranial magnetic and electrical brain stimulation
- State-of-the-art peripherals including fast eye trackers and Propixx projectors
- Clinical collaborations allowing access to single unit and LFP recordings in patients undergoing pre-surgical evaluation
- High-speed computer facilities for analysis, data storage and sharing

A particular focus of the Centre will be on developing and understanding the use of combinations of these technologies to provide a more complete picture of brain structure and function.

Excellent research opportunities are provided by our links to the University of Birmingham's Institute for Mental Health, Queen Elizabeth Hospital Birmingham, Birmingham Children's Hospital and the Barberry National Centre for Mental Health.

Our research will be conducted in the spirit of open and reproducible science in which collaborations and transparency are emphasised. We aim to share data and analysis approaches to achieve transparency and engage with the wider research community.

We are home to one of the UK's strongest psychology departments, ranked among the top five psychology departments for research, with a reputation for excellent teaching.

Key Projects

HUMAN MEMORY

Memory allows us to mentally travel back in time to relive past experiences. Remembering is a reconstructive process that is heavily influenced by our expectations and prior knowledge, but how is this coded in the brain? Our memory researchers rely on intracranial electroencephalography (iEEG), functional magnetic resonance imaging (fMRI), magnetoencephalography (MEG) and transcranial electrical stimulation (tES) to investigate how different brain regions interact to support memory encoding and retrieval.

VEGETATIVE STATE

Our researchers are exploring the potential for electrical brain stimulation to restore motor function in vegetative states. Our goal is to develop effective interventions to increase external responsiveness in patients with a prolonged disorder of consciousness after severe brain injury. Scientifically, this research will provide new insight into how the motor system generates voluntary actions.

UNDERSTANDING APPETITE CONTROL

Whilst we know that metabolic signals and cognitive processes directly influence food rewards, we know very little about how these factors interact to affect appetite control. Our pioneering approach to the study of food choice has the possibility to develop effective interventions to help people control their food intake.

THE MANY FACETS OF SLEEP

Sleep is a complex and dynamic process that impacts on virtually every aspect of life. We are using a variety of approaches to understand how and why sleep is important. Using brain imaging and electrophysiological approaches we are investigating memory reactivation during sleep in relation to learning. We are developing links with local sleep clinics to translate our findings into improvements in patient care and greater understanding of sleep disorders.

BRAIN OSCILLATIONS: UNDERSTANDING THE BRAIN AS A NETWORK

We are researching the brain as a network to uncover the mechanisms of cognition. Brain oscillations likely serve an important role for timing and coordinating the exchange of information between brain regions. Individuals with attention problems such as ADHD patients and the elderly are also investigated with the aim of uncovering malfunctions in brain oscillations that can explain the cognitive mechanisms underlying these challenging disorders.

MULTIMODAL INTEGRATION

We place a strong emphasis on developing and applying the data acquisition and analysis techniques that are needed when methods are combined. In particular, recording EEG and fMRI data simultaneously has the potential to provide a more comprehensive picture of when and where brain regions are active during a task or a complex behaviour such as sleep.

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