Australian Brain Alliance

CRACK THE BRAIN'S CODE

NEUROTECHNOLOGY AND EPILEPSY

What is epilepsy?

Epilepsy is a chronic disorder of the brain characterized by recurrent seizures.

The brain contains millions of neurons, which are constantly communicating. Neurons send chemical signals that either excite, or inhibit electrical signals within the brain.

If the chemical signalling between neurons is disturbed, it can lead to either excessive or synchronous activity within the brain—a surge of electrical activity that results in a seizure.

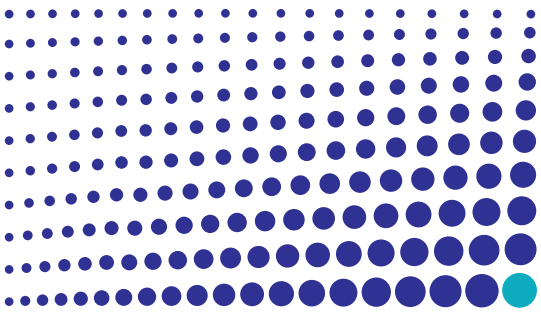
Seizures can occur in different regions of the brain, and have different effects on motor control, sensation and feeling, awareness and consciousness and behaviour. They can also vary in severity, sometimes being mistaken for daydreaming, other times, they can cause a loss of consciousness.

Epilepsy is not one single condition—there are around 40 different types of epilepsy syndromes.

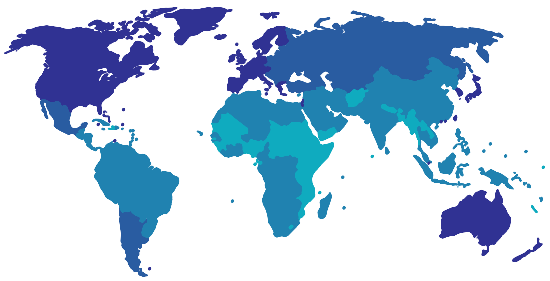
While some cases of epilepsy have been linked to injury, stroke or brain infections, for more than half of epilepsy cases, the cause is unknown.

While progress has been made with developing treatments for epilepsy, around 30% of people who experience uncontrollable seizures don't respond to treatment.

1 in 200 children live with epilepsy.



More than 65 million people worldwide have epilepsy. 80% of them live in developing countries.



New research brings seizure prediction warning system closer to reality

Surveys of epilepsy patients have reported that the unpredictability of seizures is one of their biggest concerns. Researchers at the University of Melbourne and IBM Research-Australia have applied the power of deep learning and neuromorphic computing to build a device that has been able to predict the onset of epileptic seizures.

The researchers analysed the brain activity EEG data from 10 patients, and developed algorithms that predicted the onset of seizures and proved to be successful in predicting seizures 69 per cent of the time.

The heavy computing is carried out by IBM's brain-inspired neuromorphic computing chip.

Designed to emulate the function of the human brain, this powerful chip is the size of a postage stamp, and runs on the same energy requirements as a hearing aid.

The deep-learning neural networks 'learn' to recognise specific brain activity patterns associated with seizures for individual patients. Given epilepsy manifests itself uniquely in each person, this is an important step forward from previous research.

As opposed to relying on various features hand-picked by clinical experts, the technology automatically learns which patterns of brain activity indicate the onset of a seizure. The system would then alert the wearer when their brain is showing signs of an upcoming seizure. The sensitivity of the device could be adjusted, as the wearer may choose to ignore 'low-level' alerts while sleeping, yet might prefer to receive highly sensitive alerts while socialising or driving.

The EEG information used to develop the device was obtained from electrodes implanted within patients' brains from an earlier study with St Vincent's hospital. The researchers are working towards advancing the deep learning algorithm so it can be effective on data collected from an external EEG device, which would make the application less invasive and more scalable.

The ability to predict an impending seizure could benefit the quality of life for many people with epilepsy, but researchers imagine a future where this technology could be used to combine seizure prediction with brain stimulation to effectively shut down the seizure before it can take hold.

The Australian Brain Initiative will nurture the basic brain research required to better understand how the brain functions and explore the research needed to effectively treat disorders like epilepsy. The Initiative will also progress collaboration between research and industry to advance neurotechnology devices that have the potential to transform both the capabilities of neuroscience research but also the lives of those living with conditions and disorders of the brain.

For 60% of epilepsy cases, there is no known cause.

More than 250,000 Australians are currently living with epilepsy.