

PRESS RELEASE

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Ground-breaking research into memory honoured with the world's largest prize for brain research

Three British neuroscientists have today (1 March) won the world's most valuable prize for brain research, for their outstanding work on the mechanisms of memory. This year's winners of The Brain Prize are Tim Bliss, Graham Collingridge and Richard Morris.

The Brain Prize, awarded by the Grete Lundbeck European Brain Research Foundation in Denmark is worth one million Euros. Awarded annually, it recognises one or more scientists who have distinguished themselves by an outstanding contribution to neuroscience.

The research by Professors Bliss, Collingridge and Morris has focused on a brain mechanism known as 'Long-Term Potentiation' (LTP), which underpins the life-long plasticity of the brain. Their discoveries have revolutionised our understanding of how memories are formed, retained and lost.

The three neuroscientists have independently and collectively shown how the connections – the synapses - between brain cells in the hippocampus (a structure vital for the formation of new memories) can be strengthened through repeated stimulation. LTP is so-called because it can persist indefinitely. Their work has revealed some of the basic mechanisms behind the phenomenon and has shown that LTP is the basis for our ability to learn and remember.

Sir Colin Blakemore, chairman of the selection committee said "Memory is at the heart of human experience. This year's winners, through their ground-breaking research, have transformed our understanding of memory and learning, and the devastating effects of failing memory."

Without the capacity to store information in our brains, we could not remember our past and would be incapable of planning our future. Without memory, we could not recognise other people, find our way around in the world or make decisions based on past evidence. We could not learn language, ride a bicycle, drive a car, or use a smart phone. There could be no education, no literature or art.

Responding to the news of the award, Tim Bliss, visiting worker at the Francis Crick Institute in London, said "I am of course delighted to be awarded a share of this prestigious prize. Research into LTP has been a wonderfully stimulating field to work in. Experimentally it can be studied at so many levels, from the molecular machinery that underpins it to the behaviours that depend on it. And from the beginning it has held up the promise of explaining the neural basis of memory."

Richard Morris, professor of neuroscience at the University of Edinburgh, said, "I am naturally honoured to receive a share of this prize. All of us have had the good fortune to run laboratory teams, including graduate students and postdoctoral researchers. We acknowledge our debt to them and hope that the award of this prize recognizes the fundamental importance of their contributions. While much of the work we have done on LTP has been driven by our curiosity about how the brain stores memories, it is inevitable that knowledge of basic mechanisms will lead to approaches for alleviating the pathologies of memory that are becoming increasingly prominent in our ageing society."

Graham Collingridge, professor of neuroscience in anatomy at the University of Bristol, chair of the

department of physiology at the University of Toronto and senior investigator at the Lunenfeld-Tanenbaum Research Institute of Mount Sinai Hospital, Toronto, Canada, said “I am delighted to share this award. Working on the cellular mechanisms of learning and memory has been both richly challenging and intensely rewarding for me. I am really excited about now translating discoveries about LTP into new treatments for dementia”.

The award to three UK neuroscientists testifies to the strong and sustained support that the UK funding bodies, particularly the Medical Research Council, have given to their research over the past three decades.

The strength of the connections between neurons in the brain – the synapses – can change in response to experience. LTP exemplifies this inherent plasticity, which underlies the brain’s remarkable capacity to reorganise itself, at least to some extent, after damage such as a stroke, or after the loss of normal input, as in blindness.

Conversely, deficits and disorders in the capacity to alter synaptic strength appears to be involved in many brain-related conditions that affect millions of people around the world, including autism, schizophrenia, stress, anxiety, depression, chronic pain, epilepsy and addiction. New and emerging knowledge of the role of LTP will help guide the way to improving treatments.

Tim Bliss and his Norwegian colleague, Terje Lømo, gave the first detailed description of long-term potentiation as early as 1973. Since then, Bliss has continued to be a driving force in LTP research, concentrating on the cellular mechanisms that sustain LTP and its relation to memory.

Graham Collingridge has developed and applied techniques to identify several of the key molecules that are responsible for LTP. He is particularly known for discovering the role of the so-called NMDA receptor in the induction of LTP. The NMDA receptor is a protein in the brain that is important for communication amongst nerve cells.

In 1986, Richard Morris used a new method he had developed to show that LTP was necessary for rats and mice learn to find their way around a new environment. Using specific drugs acting at the NMDA receptor, he began a long programme of research to establish the role of LTP in memory.

Professors Bliss, Collingridge and Morris will share the prize of one million Euros, which will be presented to them at a ceremony on 1 July in Copenhagen by His Royal Highness Crown Prince Frederik of Denmark.

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NOTES TO EDITORS

- The one million Euro Brain Prize is awarded by the independent, charitable Grete Lundbeck European Brain Research Foundation.
- In 2016, the Prize will be awarded for the sixth consecutive year. This year it will be awarded to ground-breaking research into the cellular and molecular basis of the phenomenon of long-term potentiation and for showing that this form of plasticity in neural connections is the basis for memory and learning.

- The Brain Prize is a personal prize, awarded to one or more scientists who have achieved distinction through outstanding contributions to European brain research.

The Grete Lundbeck European Brain Research Prize - The Brain Prize - is awarded by Grete Lundbeck European Brain Research Foundation, a charitable, non-profit organization founded by the Lundbeck Foundation. The Prize and the Foundation are both named after Grete Lundbeck, visionary founder of [Lundbeck Foundation](http://www.lundbeck-foundation.com). More information can be found on The Brain Prize website, www.thebrainprize.org

About long-term potentiation

The human brain consists of approximately 100 billion neurons. They are interconnected via synapses, which allow the neurons to communicate with each other. On average, there are probably about 5,000 synapses on each neuron. That means that the total number of synapses in the brain might be a staggering 500 trillion.

Many synapses show a persistent increase in strength as a result of brief periods of intense activity. As a result of this phenomenon, known as long-term potentiation, synapses become more effective. It is this increased and more efficient communication that may enable us to store new information such as the layout of a new house, or to recognise friends and family. The key contribution of the three winners was to identify LTP, work out its mechanisms and establish its relevance for memory.

Synapses can also be weakened - so-called long-term depression - and this mechanism is also used in the acquisition of in particular, motor skills. Long-term potentiation and long-term depression are examples of synaptic plasticity, i.e. the fact that the brain is able to change and is not static. It also means that, to a certain extent, the brain is able to restore functions that are lost, for example due to cerebral thrombosis.

LTP, the phenomenon that Bliss, Collingridge and Morris have studied, was first described in the part of the brain known as the hippocampus, which is responsible among other things for acquisition of episodic memory (memory for the events of our lives). Synaptic communication is characterised by a neuron releasing a neurotransmitter (glutamate) which is then captured by receptors on the target neuron, triggering a response.

There are various types of glutamate receptor. So-called AMPA receptors are activated each time the synapse is active, and they are responsible for basic communication between cells. NMDA receptors are only efficiently activated when synapses are repeatedly stimulated in specific patterns. Activation of this receptor causes long-term potentiation by strengthening signal transmission through AMPA receptors.

Activation of the NMDA receptor occurs most readily when the cells on either side of the synapse release a near simultaneous nerve impulse; the receptor then acts as a coincidence detector, linking the activity of the two different neurons. This mechanism may govern associative memory, for example the fact that we associate the scent of a rose with its visual image.

About the prizewinners

Timothy Bliss (75) is a visiting worker at the Francis Crick Institute, Mill Hill, London. He gained his bachelor's degree in physiology and his PhD at McGill University in Montreal. In 1967 he joined the scientific staff of the Medical Research Council at the National Institute for Medical Research in Mill Hill, London (now the Francis Crick Institute). From 1988 to 2006 he was head of the Division of Neurophysiology at NIMR. Bliss is a Fellow of the Royal Society and a Founding Fellow of the Academy of Medical Sciences. His previous awards include the Bristol Myers Squibb Prize for Neuroscience, the Feldberg Prize and the Ipsen Prize for Neuronal Plasticity. He delivered the Croonian prize lecture at the Royal Society in 2012.

Graham Collingridge (61) is Chair of the Department of Physiology at the University of Toronto and a senior investigator at the Lunenfeld-Tanenbaum Research Institute of Mount Sinai Hospital, Toronto. He gained his bachelor's degree in pharmacology at Bristol University and his PhD at the School of Pharmacy, University College London. After postdoctoral training in Vancouver and Sydney he spent most of his career at the University of Bristol where he was a member of the Departments of Pharmacology and of Anatomy, the Director of the MRC Centre for Synaptic Plasticity and, currently, he is in the School of Physiology, Pharmacology & Neuroscience. Collingridge is a Fellow of the Royal Society and a Founding Fellow of the Academy of Medical Sciences. He has previously been awarded the Gaddam Memorial Prize, the Santiago Grisolia Prize and the Feldberg Prize.

Richard Morris (67) is Professor of Neuroscience at the University of Edinburgh, Visiting Professor at the Centre for Brain Development and Repair in Bangalore in India, and Caro Almela Professor of Neurobiology (Honorary) at the Institute for Neuroscience in Alicante, Spain. Morris read the Natural Sciences Tripos at the University of Cambridge and gained his D.Phil. at the University of Sussex. From 1977 to 1986, he was a Lecturer in physiological psychology at the University of St Andrews, and has worked at the University of Edinburgh since 1986. Morris is a Fellow of the Royal Society of Edinburgh, a Founding Fellow of the Academy of Medical Sciences and a Fellow of The Royal Society of London. He is a Fellow of the American Academy of Arts and Sciences and Foreign Fellow of the Norwegian Academy of Science and Letters. He has previously been honoured with the Feldberg Prize, the IPSEN Prize for Neuronal Plasticity and a Royal Medal for Life Science by the Royal Society of Edinburgh.