

Dr Martin Vreugdenhil

Lecturer in Neurobiology

Neurobiology

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About

Dr Martin Vreugdenhil is lecturer in Neurobiology. His research focuses on the mechanisms that synchronise neuronal activity. The brain spends much energy in synchronising neuronal activity into fast (30-100 Hz: gamma) brain rhythms and the main question addressed is what is the nature and the role of gamma frequency activity? Because it is becoming increasingly clear that gamma frequency activity is instrumental in higher cognitive functions the next question is what happens to it in diseases affecting normal cognition, like in schizophrenia and epilepsy, but also in normal brain ageing.

His aim is to address these questions in an integrative way, on levels of analysis ranging from cellular to behavioural.

In his teaching Dr Martin Vreugdenhil also aims to approach neurobiology in an integrated way. He stresses the importance of the behavioural consequences when discussing the nitty gritty of cellular neurophysiology, and vice versa addresses the underlying cellular and network mechanisms when dealing with brain diseases.

Qualifications

- PhD in Neuroscience 1994
- MS in Medical Biology 1989

Biography

Dr Martin Vreugdenhil differentiated from a start in Biology to a masters degree in Medical Biology at the University of Leiden, The Netherlands. Because a strong interest in Neuroscience was kindled he took on his first research post in the University of Amsterdam studying epileptogenesis at a cellular level. He obtained his PhD on a thesis titled: "Intrinsic properties of hippocampal pyramidal neurons after kindling epileptogenesis". As Research Fellow he studied the effect of antiepileptic drugs on intrinsic properties like calcium currents and sodium currents and how sensitivity was changed by epileptogenesis in the kindling model of epilepsy and in tissue resected from pharmaco-resistant epilepsy patients.

In 1997 he moved to the UK to join the group of Prof John Jefferys at the University of Birmingham, where he studied the cellular and network mechanisms underlying titanic stimulus-induced gamma oscillations and changes the cellular and network mechanisms underlying tetanus toxin-induced epilepsy.

In 2001 he was appointed lecturer in Neurobiology at the University of Birmingham, focussing increasingly on the physiological role of gamma frequency synchronising mechanisms, moving gradually into behavioural assessment of cognitive functions to determine the relation with gamma frequency activity, in collaboration with the Psychobiology Group of the School of Psychology.

Teaching

- BMedSc Neuroscience II and Neuroscience III modules
- Coordinator of the 3rd year BMedSc module Neurobiology of the Brain
- Coordinator of the Home Office licence course

Postgraduate supervision

Dr Martin Vreugdenhil is supervisor of one PhD student

Research

Dr Martin Vreugdenhil studies the role of synchronisation of neuronal activity at millisecond precision in normal brain function, by characterising the underlying mechanisms, and the relation with behaviour, using *in vitro* and *in vivo* electrophysiology in combination with behavioural observations and cognitive tests. He is interested in how CNS active drugs, like recreational drugs affect neuronal synchronisation and how impairments in neuronal synchronisation observed in normal brain ageing, dementia, schizophrenia and in epilepsy affect cognitive functions.

Currently his research focuses on the effect of normal ageing on cognitive functions and the underlying changes in gamma frequency activity, emerging from neuronal networks affected by the various subtle changes associated with normal ageing.

A new emerging theme is the effect of hallucinogenic drugs on perception and related gamma frequency activity in the neocortex, which may reveal what changes underlie psychosis, associated with pathologies like schizophrenia and dementias.

Other activities

Dr Martin Vreugdenhil organises the weekly Lunchtime Experimental Neuroscience Seminar (LENS) series, which aims to facilitate collaboration within the experimental neuroscience community, spread over different schools and locations.

He is a member of the Birmingham Ethical Review Sub Committee and the Biological safety Officer for Neuroscience.

Publications

Research papers:

C.B. Lu, J.G.R. Jefferys, E.C. Toescu and M. Vreugdenhil (2010). In vitro hippocampal gamma oscillation power as an index of in vivo CA3 gamma oscillation strength and spatial reference memory. **Neurobiol. Learn. Memory** doi: 10.1016/j.nlm.2010.11.008.10.1016/j.nlm.2010.11.008.

H. Anver, P.C. Ward, A. Magony and M. Vreugdenhil (2010). NMDA receptor hypofunction phase-couples gamma oscillations in the rat visual cortex. **Neuropsychopharmacology**. 36, 519-528.

E.C.Toescu and M. Vreugdenhil (2010). Calcium and normal brain ageing. **Cell Calcium** 47, 158-164.

O.O. Oke, H. Anver, A. Magony, P. Jiruska, J.G.R. Jefferys and M. Vreugdenhil (2010) High-frequency and low-frequency gamma oscillations coexist in rat visual cortex in vitro. **Eur J Neuroscience** 31, 1435-1445.

C.B. Lu, J.B. Hamilton, A.D. Powell, E.C. Toescu and M. Vreugdenhil (2009) Effect of ageing on CA3 interneuron sAHP and gamma oscillations is activity-dependent. **Neurobiol. Aging**. In press. doi:10.1016/j.neurobiolaging.2009.05.006

A.N.J. Pietersen, N Patel, J.G.R. Jefferys and M. Vreugdenhil (2009) Comparison between spontaneous and kainate-induced gamma oscillations in the mouse hippocampus in vitro. **Eur. J. Neurosci**. 29, 2145-2156.

A.N.J. Pietersen, D.M. Lancaster, N. Patel, J.B. Hamilton and M. Vreugdenhil (2009) Modulation of gamma oscillations by endogenous adenosine through A₁ and A_{2A} receptors in the mouse hippocampus. **Neuropharmacology** 56, 481-492.

A.S. Nateri, G Raivich, C. Gebhardt, C Da Costa, H. Naumann, M. Vreugdenhil, M. Makwana, S. Brandner, R.H. Adams, J.G.R. Jefferys, O. Kann and A. Behrens (2007) ERK activation causes epilepsy by stimulating NMDA receptor activity. **EMBO J**. 26, 4891-4901.

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