



## Dr Cian O'Donnell

Lecturer in Computer Science

### Area of research

Computational & Theoretical Neuroscience

Office 3.33 MVB  
Merchant Venturers Building,  
Woodland Road, Clifton BS8 1UB

[\(See a map\)](#)

+44 (0) 117 3315235

+44 (0) 117 3315235

[cian.odonnell@](mailto:cian.odonnell@bristol.ac.uk)

[bristol.ac.uk](http://bristol.ac.uk)

### Summary

I use computational and mathematical modeling to study synapses, neurons, circuits, and how the brain works.

- **Synaptic plasticity and long-term memory**  
Spike-timing-dependent plasticity, memory consolidation, biochemical signalling.  
What computational functions do molecular signals perform for memory?
- **Neural data analysis tools**  
Developing analysis tools for "big" neural circuit recording data.  
How can we analyse the activity of more than ~10 neurons at a time?
- **Fragile-X Syndrome and Autism**  
What is different about neural circuits in the autistic brain? How does this affect neural coding?

### Biography

My research uses computational and mathematical modelling to understand how the brain works. I focus on synaptic plasticity (the basis for learning and memory) and the dynamics of neural circuits. Most existing theoretical accounts of brain function ignore molecular neurobiology completely: my aim is to reverse this trend by discovering the computational function of these molecular mechanisms for learning. I'm also interested in applying ideas from theoretical neuroscience to help understand brain disorders such as Autism, Schizophrenia and Depression.

I did my undergraduate in Applied Physics at Dublin City University before switching fields to computational neuroscience for postgrad. This took me to Edinburgh, where I did an MSc and PhD in computational neuroscience in the School of Informatics. I then spent three years doing postdoctoral research at the Salk Institute in sunny San Diego, California, and have returned to the UK to take up a Lectureship in Computer Science at Bristol.

### Teaching

I teach Introduction to Computer Architecture for year 1, and Computational Neuroscience for year 3.

### Keywords

- Neuroscience
- Computational Biology

- Machine Learning

## Memberships

### Organisations

[Department of Computer Science](#)

[Wellcome PhD in Neural Dynamics](#)

### Other sites

- [Computerscience](#)
- [Neuroscience](#)

### Research Groups

- [Intelligent Systems](#)
- [Computational Neuroscience - Core](#)

### Links

-  [Homepage](#)

### Recent publications

- O'Donnell, C, Goncalves, JT, Whiteley, NP, Portera-Cailliau, C & Sejnowski, TJ, 2017, '[The population tracking model: a simple, scalable statistical model for neural population data](#)'. *Neural Computation*, vol 29., pp. 50-93
- Walker, AS, Neves, G, Grillo, F, Jackson, RE, Rigby, M, O'Donnell, C, Lowe, AS, Vizcay-Barrena, G, Fleck, RA & Burrone, J, 2017, '[Distance-dependent gradient in NMDAR-driven spine calcium signals along tapering dendrites](#)'. *Proceedings of the National Academy of Sciences of the United States of America*, vol 114., pp. E1986-E1995
- O'Donnell, C, Gonçalves, JT, Portera-Cailliau, C & Sejnowski, TJ, 2017, '[Beyond excitation/inhibition imbalance in multidimensional models of neural circuit changes in brain disorders](#)'. *eLife*, vol 6.
- Williams, A, O'Donnell, C, Sejnowski, TJ & O'Leary, T, 2016, '[Dendritic trafficking faces physiologically critical speed-precision tradeoffs](#)'. *eLife*, vol 5.
- O'Donnell, C & van Rossum, MCW, 2015, '[Spontaneous action potentials and neural coding in unmyelinated axons](#)'. *Neural Computation*, vol 27., pp. 801-18
- O'Donnell, C & Sejnowski, TJ, 2014, '[Selective memory generalization by spatial patterning of protein synthesis](#)'. *Neuron*, vol 82., pp. 398-412
- O'Donnell, C & van Rossum, MCW, 2014, '[Systematic analysis of the contributions of stochastic voltage gated channels to neuronal noise](#)'. *Frontiers in Computational Neuroscience*, vol 8., pp. 105
- O'Donnell, C, Nolan, MF & van Rossum, MCW, 2011, '[Dendritic spine dynamics regulate the long-term stability of synaptic plasticity](#)'. *Journal of Neuroscience*, vol 31., pp. 16142-56
- O'Donnell, C & Nolan, MF, 2011, '[Tuning of synaptic responses: an organizing principle for optimization of neural circuits](#)'. *Trends in Neurosciences*, vol 34., pp. 51-60
- Cannon, RC, O'Donnell, C & Nolan, MF, 2010, '[Stochastic ion channel gating in dendritic neurons: morphology dependence and probabilistic synaptic activation of dendritic spikes](#)'. *PLoS Computational Biology*, vol 6.

[View complete publications list](#) in the University of Bristol publications system

### Courses

Dr O'Donnell currently teaches 3 courses: