Dr. Michael James Winding

Personal Information

Affiliation: The Francis Crick Institute, London, UK
Email: michael.winding@crick.ac.uk
Website: https://mwinding.github.io

Research Vision: Social interactions are observed across the animal kingdom and govern many important human activities, including art, society, and war. However, we do not have synapse-resolution maps of the underlying neuronal circuits, so the computations that drive these interactions are unclear. The technology to map even a small fraction of the human brain does not exist, so I study social behaviours in insects. I have generated the first synapse-resolution wiring diagram of an insect brain, that of the fruit fly larva (*Drosophila melanogaster*). I linked genetic tools to individual circuit elements in this connectome, facilitating behavioural and functional experiments. Using these tools, I aim to understand the neural computations underlying social behaviours and how they can be perturbed. I will investigate how social isolation or mutation of disease-related genes affects brain structure to disrupt social behaviours. I aim to then restore normal social behaviours in animals with abnormal brain wiring using optogenetic activation of affected circuits.

Professional Experience

2023.04.24 - current
Group Leader, The Francis Crick Institute
Founded the Social Circuits and Connectomics Laboratory

2019.09.16 - 2023.04.23
Research Associate, University of Cambridge, Department of Zoology
Advisors: Dr. Marta Zlatic and Dr. Albert Cardona
Project: The complete connectome of an insect brain

2016.10.01 - 2019.09.13
Postdoctoral Associate, HHMI/Janelia Research Campus, USA
Advisor: Dr. Marta Zlatic
Project: Integration of conflicting valence signals during action selection

2011.08.01 - 2016.09.01
Graduate Student, Northwestern University, USA
Advisor: Dr. Vladimir I. Gelfand
Project: Cytoskeleton rearrangement in neurodevelopment and oogenesis

2009.01.13 - 2011.05.04
Undergraduate Researcher/REU Fellow, University Notre Dame, USA
Advisor: Dr. Kevin T. Vaughan
Project: Dynein's role in the mitotic spindle assembly checkpoint

Education

2011.09.01 - 2016.09.01
Ph.D. in the Field of Life Sciences (Cell and Molecular Biology)
Northwestern University, Chicago, IL, USA
Advisor: Dr. Vladimir I. Gelfand

2007.08.28 - 2011.08.10
Bachelor of Science in Biology
University of Notre Dame, Notre Dame, IN, USA

2007.08.28 - 2011.08.10
Bachelor of Arts in Studio Art
University of Notre Dame, Notre Dame, IN, USA

Manuscripts [1]

1. Pedigo BD, Powell M, Bridgeford EW, **Winding M**, Priebe CE, Vogelstein JT. *Generative network modeling reveals quantitative definitions of bilateral symmetry exhibited by a whole insect brain connectome.* eLife (in review). 2023. bioRxiv: https://doi.org/10.1101/2022.11.28.518219

Publications [17]

1. **Winding M**[†'*], Pedigo BD*, Barnes C, [and 14 others], Priebe CE, Vogelstein JT[†], Zlatic M**[,†], Cardona A**[,†]. *The connectome of an insect brain.* Science. 2023. doi: https://doi/10.1126/science.add9330
*co-first, **joint supervision, [†]co-corresponding authors

2. Pedigo BD, **Winding M**, Priebe CE, Vogelstein J. *Bisected graph matching improves automated pairing of bilaterally homologous neurons from connectomes.* Network Neuroscience. 2023. doi: https://doi.org/10.1162/netn_a_00287

3. Croteau-Chonka EC*, Clayton MS*, Venkatasubramanian L, Harris SN, Jones BMW, Lakshmi Narayan L, **Winding M**, Masson J, Zlatic M**, Kristina T Klein**. *High-throughput automated methods for classical and operant conditioning of Drosophila larvae*. eLife. 2022. doi: https://doi.org/10.7554/eLife.70015 *co-first, ** joint supervision

4. Hayden HS, Basu A, Athreya A, Park Y, Vogelstein JT, Priebe CE, **Winding M**, Zlatic M, Cardona A, Bourke P, Larson J, Abdin M, Choudhury P, Yang W, White CW. *Distance-based Positive and Unlabeled Learning for Ranking.* Pattern Recognition. 2022. doi: 10.1016/j.patcog.2022.109085

5. Giachello NG*, Hunter I*, Pettini T, Knufer A, Pettini T, Coulson B, Cachero S, **Winding M**, Zarin AA, Kohsaka H, Fan YN, Nose A, Landgraf M, Baines RA. *Electrophysiological validation of monosynaptic connectivity between premotor interneurons and the aCC motoneuron in the Drosophila larval CNS.* J. Neurosci. 2022. doi: https://doi.org/10.1523/JNEUROSCI.2463-21.2022

6. Eschbach C*, Fushiki A*, **Winding M**, Afonso B, Andrade IV, [and 10 others], Cardona A, Zlatic M. *Circuits for integrating learned and innate valences in the insect brain.* eLife. 2021. doi**:** https://doi.org/10.7554/ELIFE.62567 *co-first

7. Eschbach C*, Fushiki A*, **Winding M**, Schneider-Mizell CM, [and 10 others], Cardona A**, Zlatic M**. *Recurrent architecture for adaptive regulation of learning in the insect brain*. Nat Neurosci. 2020. doi: https://doi.org/10.1038/s41593-020-0607-9
*co-first, **joint supervision

8. Jovanic T, **Winding M**, Cardona A, Truman JW, Gershow M, Zlatic M. *Neural Substrates of Drosophila Larval Anemotaxis.* Current Biology. 2019. doi: https://doi.org/10.1016/j.cub.2019.01.009

9. **Winding M**, Kelliher MT, Lu W, Wildonger J, Gelfand VI. *Role of kinesin-1-based microtubule sliding in Drosophila nervous system development.* PNAS. 2016. 113(34). doi: https://doi.org/10.1073/pnas.1522416113

10. **Lu W***, **Winding M***, Lakonishok M, Wildonger J, Gelfand VI. *Microtubule-microtubule sliding by kinesin-1 is essential for normal cytoplasmic streaming in Drosophila oocytes*. PNAS. 2016. 113(34). doi: https://doi.org/10.1073/pnas.1522424113 ***co-first**

11. Engelke MF, **Winding M**, Yue Y, Shastry S, Teloni F, Reddy S, Blasius TL, Soppina P, Hancock WO, Gelfand VI, Verhey KJ. *Engineered kinesin motor proteins amenable to small-molecule inhibition*. Nat Commun**.** 2016 Apr 5; 7:11159. doi: https://doi.org/10.1038/ncomms11159

12. del Castillo U, **Winding M**, Lu W, Gelfand VI. *Interplay between kinesin-1 and cortical dynein during axonal outgrowth and microtubule organization in Drosophila neurons*. eLife. 2015. doi: https://doi.org/10.7554/eLife.10140

13. Jolly A, Luan C, Dusel B, Dunne S, **Winding M**, Dixit V, Robins C, Saluk J, Logan D, Carpenter A, Cohen A, Gelfand VI. *A Genome-wide RNAi screen for Microtubule Bundle Formation and Lysosome Motility Regulation in Drosophila S2 Cells.* Cell Rep**.** 2016. 14(3):611-20. doi: https://doi.org/10.1016/j.celrep.2015.12.051

14. del Castillo U, Lu W, **Winding M**, Lakonishok M, Gelfand VI. *Pavarotti/MKLP1 regulates microtubule sliding and neurite outgrowth in Drosophila neurons.* Curr Biol. 2015. 25(2):200-5. doi: https://doi.org/10.1016/j.cub.2014.11.008

15. **Winding M**, Gelfand VI. *Breaking up isn't easy: myosin V and its cargoes need Dma1 ubiquitin ligase's help.* Dev Cell**.** 2014. 28(5): 479-480. https://doi.org/10.1016/j.devcel.2014.02.016

16. Kasuboski JM, Bader JR, Vaughan PS, Tauhata SB, **Winding M**, Morrissey MA, Joyce MV, Boggess W, Vos L, Chan GK, Hinchcliffe EH, Vaughan KT. *Zwint-1 is a novel Aurora B substrate required for the assembly of a dynein-binding platform on kinetochores.* Mol Bio Cell. 2011. 22(18): 3318-30. doi: https://doi.org/10.1091/mbc.e11-03-0213

17. Bader JR, Kasuboski JM, **Winding M**, Vaughan PS, Hinchcliffe EH, Vaughan KT. 2011. *Polo-like kinase1 is required for recruitment of dynein to kinetochores during mitosis.* J Biol Chem. 2011. 286(23): 20769-77. doi: https://doi.org/10.1074/jbc.m111.226605

Teaching

2022 and 2019	Demonstrator for Cell Microscopy Course, University of Cambridge
2019.02.04 - 2019.04.05	Completed "*Scientists Teaching Scientists"* Course (Certificate)
2012.09.01 - 2014.05.01	Mentored high-school student during RNAi project (IMSA SIR program)
2013.01.07 - 2013.03.16	Assisted in a graduate-level Cell Biology course, including a lecture
2010.08.24 - 2010.12.09	Assisted in a Cellular Biology Laboratory course (BIOS 31341)
2010.01.12 - 2010.04.28	Mentored undergraduates throughout a semester-long research project

Supervisory and Service

2022.12.01 - 2023.01.15	Reviewed abstracts for Cosyne 2023
2021.02.25 - 2021.07.21	Digital Presence Working Group (Zoology), University of Cambridge
2020.10.28 - 2020.11.03	Led CATMAID Tracing Workshop, University of Cambridge
2020.03.24 - 2021.01.20	Led team reconstructing the larval brain, University of Cambridge
2018.10.24 - 2020.11.03	Trained visiting scientists and new hires in EM reconstruction
2018.07.18 - 2019.09.16	Supervised research specialist in split-GAL4 screening project
2015.09.09	Reviewed a manuscript for *PLOS ONE*

Workshops and Outreach

2023.03.24 Interviewed on live radio, *Radio New Zealand*

2023.03.16 Wrote an article for *The Conversation*, aimed at a lay audience

2020.12.01-2 Led workshop '*Collaborative neuron tracing, analysis and data sharing with CATMAID*'
From Images to Knowledge (I2K) Virtual Conference, Janelia HHMI, USA.

Research Talks

2022.05.29 Connectomics Conference, Berlin, Germany
2021.12.02 Neuromatch Conference, USA
2021.10.20 Plenary Speaker, Neurogenetics of *Drosophila* Larva, Bloomington, IN, USA
2021.05.10 Monthly Maggot Meeting (international seminar series), Cambridge, UK
2021.05.05 NeuroFly Conference, Madrid, Spain
2019.04.14 Max Planck / HHMI Connectomics Meeting, Berlin, Germany
2016.04.22 Chicago Cytoskeleton, Chicago, IL, USA

Posters

2022.09.26 The Assembly and Function of Neural Circuits, Ascona, Switzerland
2018.10.08 Behavioural Neurogenetics of *Drosophila* Larva, Edinburgh, UK
2016.03.18 Chicago Cytoskeleton, Chicago, IL, USA
2015.10.24 Midwest *Drosophila* Conference, Monticello, IL, USA
2015.03.20 Chicago Cytoskeleton, Chicago, IL, USA
2014.12.09 American Society for Cell Biology Meeting, Philadelphia, PA, USA
2014.03.14 Chicago Cytoskeleton, Chicago, IL, USA
2010.12.13 American Society for Cell Biology Meeting, Philadelphia, PA, USA

Awards and Distinctions

2016.07.22 **Driskill Research Award** (for Exceptional PhD), Northwestern University, USA
2015.10.24 Best Poster Award, Midwest *Drosophila* Conference, Monticello, IL, USA
2011.05.21 Best of Show, B.A. Studio Art Thesis Exhibit

Funding

2023.04.24 Internal Funding, the Francis Crick Institute

2019.09.01 ERC-2018-COG: *Principles of Learning in a Recurrent Neural Network*
(PI: Marta Zlatic)*
***Role**: contributed data

2015.09.15 NIH R01: *Microtubule motors and generation of cell polarity* (PI: Vladimir Gelfand)*
***Role:** writing and figure generation

2014.10.24 Northwestern Conference Travel Grant (CTG)
2010.06.21 NSF Research Experience for Undergraduates (REU) Fellowship
2010.12.11 Center for Undergraduate Scholarly Engagement (CUSE) Travel Award