William Duncan Martinson
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Education

University of Oxford, Balliol College Oxford, UK Graduated August 2022
D.Phil. in Mathematics
Doctoral thesis title: Follow the leader: collective cell migration in cancer and developmental biology.
Supervisors: Prof. Philip K. Maini, Prof. Helen M. Byrne

Brown University Providence, RI, USA Graduated May 2018
Honors Sc.B. in Applied Mathematics-Biology, magna cum laude (highest honors awarded), Phi Beta Kappa, GPA: 4.0/4
Senior honors thesis title: Long-time integration of reaction transport and application to coagulation kinetics.
Supervisors: Prof. Martin R. Maxey, Dr. Alireza Yazdani.

Research Experience

INI-Simons Postdoctoral Research Fellow, University of Cambridge Cambridge, UK July 2023 – Present
Granted a one-year postdoctoral fellowship funded by the Isaac Newton Institute (INI) and the Simons Foundation to attend the programme "Mathematics of Movement" and build an international collaborative network. Conduct independent research in the mathematical modelling of collective movement. Unite techniques from data science, statistics, and mathematical biology to create novel data-driven models to assess the impact of individual heterogeneity on collective behaviour.

Postdoctoral Research Associate, Oxford University Oxford, UK January 2022 – July 2023
Analysed mathematical frameworks called aggregation-diffusion equations to model long-range cellular interactions in collective migration and pattern formation. Applied Bayesian parameter estimation methods to fit these models to experimental and synthetic data. Collaborated with experimental biologists in Spain and the United States to explain their observations with mathematical modelling. Developed and programmed novel numerical algorithms for simulating models that mix elements of individual-based and continuous frameworks. Co-organised the July 2023 OxPDE workshop on Topics in Collective Migration, Neuroscience, and Parameter Estimation.

D.Phil. Research, Mathematical Institute, Oxford University Oxford, UK October 2018 – December 2021
Investigated mathematical models for collective cell migration within the contexts of embryonic development and tumour-induced angiogenesis (blood vessel formation). Applied techniques from asymptotic analysis to demonstrate equivalences between several microscopic individual-based models (IBMs) and macroscopic population-level models for angiogenesis. Collaborated with theoreticians and experimentalists to create a new IBM for neural crest stem cell migration within a dynamic microenvironment. Identified dominant mechanisms directing cells and guided *in vivo* experimental design.

Senior Undergraduate Thesis, Brown University Providence, RI February 2017 – June 2018
Developed and simulated a mathematical model for blood clotting (thrombosis) in a two-dimensional vessel experiencing blood flow. This project aimed to help physicians better analyse the development of blood clots over long time periods by making simulations of their onset more efficient and accurate.

University of Michigan, Summer Undergraduate Research Fellow Ann Arbor, MI May 2017 – August 2017
Conducted genetic and biochemical screens for blood clotting (thrombosis) under the supervision of Dr. Jordan Shavit, a hematologist/oncologist, in a zebrafish animal model. Assisted in the development of new methods for identifying genetic and biochemical modifiers of thrombosis.

Peer-reviewed Publications

Martinson W.D., Volkening A., Schmidtchen M., Venkataraman C., Carrillo J. (submitted). Linking continuous and discrete models of cell birth and migration. arXiv:2308.16093.

Terragni F., **Martinson W.D.**, Carretero M., Maini P.K., Bonilla L.L. (2023). Soliton approximation in continuum models of leader-follower behavior. *Physical Review E 108 (5)*, 054407. DOI: 10.1103/PhysRevE.108.054407

Martinson W.D., McLennan R., Teddy J.M., McKinney M.C., Davidson L.A., Baker R.E., Byrne H.M, Kulesa P.M., Maini P.K. (2023). Dynamic fibronectin remodeling prevents collective cell jamming in a cell-based mathematical model. *eLife 12*, e83792. arXiv:2209.07794. DOI: 10.7554/eLife.83792

Martinson W.D., Ninomiya H., Byrne H.M., Maini P.K. (2021). Comparative analysis of continuum angiogenesis models. *Journal of Mathematical Biology 82 (21)*, online. DOI: 10.1007/s00285-021-01570-w

Martinson W.D., Byrne H.M., Maini P.K. (2020). Evaluating snail-trail frameworks for leader-follower behavior with agent-based modeling. *Physical Review E 102 (6)*, 062417. DOI: 10.1103/PhysRevE.102.062417

Martinson W.D., Byrne H.M., Maini P.K. (2019). Multiscale modeling and simulation of traveling waves in biology: A review. *Rendiconti di Matematica e delle sue Applicazioni 40 (7)*, 191-216.

Shea, K.G., **Martinson W.D.,** Cannamela P.C., Richmond C.G., Fabricant P.D., Anderson A.F., Polousky J.D., Ganley T. J. (2018). Variation in the medial patellofemoral ligament origin in the skeletally immature knee: An anatomic study. *The American journal of sports medicine, 46 (2)*, 363-369. DOI: 10.1177/0363546517738002

Richmond C.G., Green D.W., Cannamela P.C., **Martinson W.D.**, Shea K.G. (2018). The distance between the hamstring grafts and the physis and apophysis of the proximal tibia – implications for pediatric ACL reconstruction and physeal arrest. *Journal of ISAKOS: Joint Disorders & Orthopaedic Sports Medicine, 3 (6)*, 318-322. DOI: 10.1136/jisakos-2018-000222

Outreach Publications

Martinson W.D. (November 2022). "From sandcastles to economics and artificial intelligence: optimal transport through the years". *The Oxford Scientist*, Michaelmas Term 2022 volume, pp. 28-29. https://oxsci.org/optimal-transport-theory/

Martinson W.D. (March 2022). "Mathematical modelling for regenerative medicine: dream or reality?". *The Oxford Scientist*, Hilary Term 2022 volume, pp. 26-27. https://oxsci.org/mathematical-modelling-for-regenerative-medicine/

Invited Talks and Conference Presentations

Invited Talk (University of Edinburgh, Scotland, UK) March 2024
Invited talk: "Multiscale modelling of collective behaviour: insights, challenges, and future perspectives".

ENUMATH 2023 Conference (Lisbon, Portugal) September 2023
Invited mini-symposium talk: "Model selection identifies proliferative heterogeneity in mouse microglia development".

INI Workshop on Collective Behaviour (Cambridge, UK) August 2023
Invited talk: "Multiscale modelling of collective behaviour: insights, challenges, and future perspectives".

INI Summer School on Mathematics of Movement (Cambridge, UK) July 2023
Contributed talk: "Extracellular matrix remodeling by neural crest cells provides a robust signal for collective migration".

2023 Mathematical Biology: Applications and Analysis Workshop (Dresden, Germany) June 2023
Invited talk: "Extracellular matrix remodeling by neural crest cells is a major determinant of robust collective migration".

Invited Talk (TU Dresden, Dresden, Germany) April 2023
Invited seminar talk: "Mathematical modeling of leader-follower migration in cancer and developmental biology".

2023 British Applied Mathematics Colloquium (Bristol, UK) April 2023
Contributed talk: "Data-driven mathematical modelling provides evidence for proliferation-driven heterogeneity of microglia during mouse development".

2023 Gordon Research Conference on Neural Crest Cells and Placodes (Barga, Italy) February 2023
Invited talk and poster: "Extracellular matrix remodeling by neural crest cells provides a robust signal for collective migration". Recipient of a Society for Mathematical Biology travel grant ($750 USD) to support my attendance.

Joint Mathematics Meetings 2023 (Boston, MA, USA) January 2023
Invited talk: "Extracellular matrix remodeling by neural crest cells provides a robust signal for collective migration".

2022 European Conference for Mathematical and Theoretical Biology (Heidelberg, Germany) September 2022
Invited mini-symposium talk: "Extracellular matrix remodelling by neural crest cells provides a robust signal for collective

migration". Co-organiser of two mini-symposia with Dr. Sara Bernardi ("Insights on collective migration using agent-based modeling", "Non-local mathematical models for collective migration: insights from analytical methods").

Mathematical Models for Biomedical Sciences Summer School (Como, Italy) June 2022
Poster presentation: "Extracellular matrix remodelling by neural crest cells provides a robust signal for collective migration."

Inference for Expensive Systems in Mathematical Biology Conference May 2022
Poster: "Extracellular matrix remodelling by neural crest cells provides a robust signal for collective migration."

2022 British Applied Mathematics Colloquium April 2022
Talk: "Extracellular matrix remodelling by neural crest cells provides a robust signal for collective migration."

2021 Society for Mathematical Biology Annual Meeting June 2021 (online)
Talk: "Extracellular matrix remodelling by neural crest cells provides a robust mechanism for collective migration".

Micro-to-Macro Modelling in Developmental Biology October 2020 (online)
Internal online symposium hosted by José Carrillo of the University of Oxford Mathematical Institute. Talk: "Comparative analysis of discrete and continuum leader-follower models."

2020 Society for Mathematical Biology Annual Meeting August 2020 (online)
Poster: "Comparative analysis of continuum angiogenesis models."

9th Annual Integrated Mathematical Oncology Workshop November 2019
Poster: "Traveling wave analysis of angiogenesis models and its implications." Recipient of a travel grant to support my attendance.

Philip Maini's 60th Birthday Workshop September 2019
Poster: "Revisiting a classical continuum model of angiogenesis: Novel insights using *in silico* data."

2019 Society for Mathematical Biology Annual Meeting July 2019
Poster: "Revisiting a classical continuum model of angiogenesis: Novel insights using *in silico* data."

University of Michigan Cardiovascular Center Undergraduate Summer Symposium August 2017
Talk: "Establishing zebrafish as a model to screen genetic factors of hormone-induced thrombosis."

Awards, Fellowships, and Honors

INI-Simons Postdoctoral Fellowship July 2023 – July 2024
Awarded a 1-year research fellowship by the Isaac Newton Institute (Cambridge, UK) and the Simons Foundation to attend the Mathematics of Movement programme and begin independent research in collaboration with UK-based faculty.

Associate Fellow, Higher Education Academy October 2021 – Present
Accredited by the Higher Education Academy of the U.K. as meeting professional standards for the teaching of undergraduate students. Learned and applied evidence-based approaches to improve my teaching practices and lesson plans for first-year mathematics students.

UCR Contributed Talk Award for Cell and Developmental Biology Awarded June 2021
Awarded at the 2021 Society for Mathematical Biology Annual Meeting in recognition of outstanding research presentation.

University of Oxford Mathematical Institute Scholarship Awarded September 2020
Awarded a 1.5-year full scholarship with stipend by the University of Oxford Mathematical Institute (equivalent to £34,000 GBP/year) to conclude my studies at the university, in recognition of my achievements as a scholar within the department.

Keasbey Fellowship Awarded December 2017
Awarded a 2-year full scholarship with stipend by the Keasbey Memorial Foundation (equivalent to £34,000 GBP/year) to pursue graduate study at the University of Oxford, in recognition of my past achievements as a scholar and of my future leadership potential.

University of Michigan Cardiovascular Center Undergraduate Research Fellowship Awarded March 2017
Awarded a three-month fully paid opportunity to conduct research with faculty members at the University of Michigan Cardiovascular Center (FCVC), in recognition of my interest and potential career in biomedical research.

Phi Beta Kappa March 2017 – Present
Elected to the Rhode Island Alpha Chapter of Phi Beta Kappa in March 2017 during my junior year by my peers in recognition of outstanding academic achievement in studies spanning the liberal arts and sciences.

Associate Member, Sigma Xi April 2018 – Present
Elected to the Brown University chapter of the Sigma Xi scientific research honor society in recognition of sustained commitment to and excellence in scientific research during my undergraduate years.

Teaching Experience

Dissertation Project Supervisor, Mathematical Institute Oxford, UK November 2022 – June 2023
Supervised thesis dissertation projects for three graduate (Master's level) students. These projects aimed to rigorously derive and analyse solutions to systems of aggregation-diffusion equations for three or more cell types. Worked 4 hours per week.

Balliol College Stipendiary Lecturer in Applied Mathematics Oxford, UK January 2023 – March 2023
Led weekly classes and small group tutorial sessions for the following first- and second-year modules: Multivariable Calculus and Numerical Analysis. Marked termly examinations and problem sheets. Led outreach sessions for prospective applicants to the undergraduate mathematics programmes at Balliol. Worked 6 hours per week during term time.

Oxford University Mathematical Institute Tutor Oxford, UK October 2022 – January 2023
Led biweekly problem sheet classes for the following fourth year/graduate module: Perturbation Methods. Work up to 6 hours per week during term time.

Balliol College Graduate Teaching Assistant Oxford, UK October 2020 – June 2022
Assisted senior fellows in the teaching and assessment of weekly problem sheet classes for the following first-year mathematics modules: Probability, Introductory Calculus, Multivariable Calculus, and Statistics & Data Analysis. Worked up to 20 hours per week during term time.

Oxford University Teaching Assistant Oxford, UK October 2018 – March 2020
Assessed student problem sheets and co-taught biweekly problem classes for the following third-year courses: Further Mathematical Biology, Numerical Solutions of Differential Equations I, Nonlinear Systems, and Mathematical Modelling. Worked up to 20 hours per week during term time.

Balliol College Graduate Mentor Oxford, UK November 2019 – June 2020
Led one-on-one tutoring sessions with a student in Balliol College for the following third-year classes in the Mathematical Institute: Further Mathematical Biology, Applied PDEs, and Nonlinear Systems. Worked 5 hours per week during term time.

Leadership Experiences

Workshop Panel Organisation September 2023
Co-organiser of an early career researcher panel at the Isaac Newton Institute workshop "Measures and Representations of Interactions". Moderated a four-member panel of senior mathematicians and research scientists by asking them about current challenges for early career researchers in science and mathematics.

Conference Organiser June 2022 – July 2023
Co-organiser of July 2023 workshop on Topics in Collective Migration, Neuroscience, and Parameter Estimation held in the University of Oxford Mathematical Institute. Invited conference speakers, arranged guest accommodation and meals, and led activities for attendees during the workshop.

Early Career Research Representative, Health and Safety Committee January 2023 – June 2023
Worked with the administration of the Mathematical Institute to review safety guidelines, such as fire safety protocols, within the department. Communicated issues raised by graduate students and postdoctoral researchers regarding safety and health.

Student Representative, Consultative Committee for Graduate Students October 2019 – October 2022
Communicated with the administration of the Mathematical Institute to address issues affecting graduate students, such as

funding or teaching. Designed and published a poster series at the Oxford University Mathematical Institute to highlight the historical contributions of women and non-binary mathematicians.

Balliol College MCR Committee, IT Officer June 2019 – June 2021
Member of the governing body for graduate students in Balliol College. Redesigned the Middle Common Room (MCR) website to improve accessibility for students. Managed the MCR website and mailing lists for graduate students.

Professional Society Memberships

European Society for Mathematical Biology March 2024 – Present
Society for Mathematical Biology March 2019 – Present
Society for Industrial and Applied Mathematics October 2018 – Present
Phi Beta Kappa March 2017 – Present
Sigma Xi May 2018 – Present

Skills and Other Interests

Language: Native in English. Fluent in French.
Technical Skills: Proficient in MATLAB, Python, Julia, C++, Latex, Git/GitHub, Microsoft Office (Word, Excel, and Powerpoint). Experience in Maple and Mathematica.
Activities: Triathlon, swimming, running, piano