SOPHIE RAYNOR

Citizenship	*Netherlands and UK*
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Post-doc,
Category theory

01/2019-21 Macquarie University, NSW, Australia.
Post-doctoral research fellow at **Centre of Australian Category Theory,**
mentored by Dr. S. Lack and Dr. R. Garner, funded by the Australian Research Council.

EDUCATION

PhD,
Mathematics

2018 University of Aberdeen, UK.
Title: **Compact symmetric multicategories and the problem of loops**
Fully funded by an award from the **Blue Brain Project, EPFL, CH**.
Supervisors: R. Levi (University of Aberdeen) and K. Hess (EPFL, Switzerland).

BScMSc,
Mathematics

2010 Leiden University, The Netherlands.
Cum Laude (First Class Honours)

BA Hons,
Philosophy

2000 King's College, Cambridge University, UK.
(MA Cantab 2004.)

RESEARCH INTERESTS

- The combinatorics of duality, genus and units. Modular operads and diagram categories. Modular operadic methods in (stable) representation theory, and stable homotopy theory.

- Applications of (higher) modular operads and graphical methods in topology, geometry, and algebra. Higher modular operads and extended CFT.

- Generalised operad theory. With focus on modular operads, and geometric and algebraic approaches to higher structures.

- Fundamental mathematics and real-world challenges. Applications of (modular) operads in computer science and data science, in particular for developing new tools aimed at **transparency of machine learning algorithms**.

PUBLICATIONS

· In pure mathematics, collaborations are listed alphabetically, and authors credited equally.
· Publication rates in pure mathematics are low and refereeing times are long relative to other sciences, and vary significantly between specialisms. It is normal for mathematicians at the beginning of their career, and particularly those working in new areas of research, to have a gap between completion of their PhD and publication of papers.

Advances in
Mathematics

· *Graphical combinatorics and a distributive law for modular operads.*
Adv. Math. (2021), https://doi.org/10.1016/j.aim.2021.108011.
Preprint at arxiv:1911.05914.

Topology and its
Applications

· *An infinity operad of normalized cacti.*
Together with L. Bonatto, S. Chettih, A. Linton, M. Robertson and N. Wahl. Accepted, Jan. 2021.
To appear in special issue of *Topology and its Applications*. Preprint at arxiv:2007.01588.

(PREPRINTS/ NEAR COMPLETION.)

Submitted,
08/2021

· *Brauer diagrams, modular operads, and a graphical nerve theorem for circuit algebras.*
Preprint at arXiv:2108.04557.

Expected, 09/2021.

· *Modular operads, and a graphical calculus and nerve for compact closed categories*

(IN PREPARATION).

Expected,
early 2022.

· *Parametrised fat graphs and an ∞-modular operad of open-closed surfaces.*

· *Models of ∞-circuit algebras and compact closed categories*
With Marcy Robertson.

· *Modular operads, duality, units and representation stability.*
With Ross Street.

· *Fat graphs and an ∞-PROP for open-closed surfaces.*
With L. Bonatto, S. Chettih, A. Linton, M. Robertson and N. Wahl.

n-CATEGORY CAFÉ BLOG POST

July 2018

· *Beyond Classical Bayesian Networks.*
With Pablo Andrez Martinez, blog post at The *n*-Category Café.

FUNDING

Visiting fellowship,
Topology

2021 · Six month guest fellowship at **Copenhagen Centre for Geometry and Topology, University of Copenhagen, Denmark.** (Not taken up due to COVID.)

Doctoral funding

2012-2016 · My PhD – based in Scotland and Switzerland, and involving frequent international travel – was fully funded by an award from the **Blue Brain Project, EPFL, CH**.

Maintenence
stipend

Jan.-July 2014 · The Blue Brain Project awarded me an extra stipend covering all costs, to spend six months at EPFL.

Selective
programme

2018-19 · Competitive selection for *Women in topology program*. Intensive collaboration and research week at the **Hausdorff Institute of Mathematics, Bonn, Germany**.

Selective
programme

Jan. - April 2018 · Competitive selection for *Applied category theory adjoint school*. Online seminar and collaborative research week at the **Lorentz Center, Leiden, NL**.

Research visit
HIM, Bonn

5 - 9 Dec. 2016 · Funded by **Hausdorff Institute for Mathematics, Bonn, Germany.**
· Research guest of Dr. M. Robertson (Melbourne). Trimester program **'Topology'**.

INVITED TALKS AT INTERNATIONAL CONFERENCES

OcHoTop
Lille, France

July 2021 · **Lille/online**, Operads, calculus, & homotopy theory methods in topology.
· **Brauer diagrams, modular operads, and a graphical nerve theorem for circuit algebras**.

SOCS 2020
Paris, France

Dec 2020 · **IRIF, Paris/online**, Species and operads in combinatorics and semantics.
· **An operadic view of compact closed categories**.

Operads Pop-Up
online

Aug. 2020 · **Worldwide/online** 24hr meeting on new developments in operad theory.
· **Unpacking the combinatorics of modular operads**.

Geocat 2020
Paris, France

July 2020 · **IRIF, Paris/online**: Geometric and categorical structures in computation and deduction. · **A distributive law for modular operads**.

JMM
Seattle, USA

Jan. 2016 · **Joint Mathematics Meetings, Seattle, USA**, AMS special session on Applied and computational topology. · **Formal perspectives on hierarchichal networks**.

Scot. Topology
Glasgow, UK

Sept. 2013 · **Glasgow University, UK**, Scottish Topology Seminar.
· **Towards a topological model of the brain**.

OTHER SELECTED TALKS

Wollongong Univ.

May 2021 · **Operator algebra and non-commutative geometry seminar**, University of Wollongong, NSW. · **Compact closed categories, modular operads and loops**.

AustMS
Online

Dec 2020 · **Conference of the Australian Mathematics Society**, University of New England, NSW, online. · **An operadic view of compact closed categories**.

EPFL
Switzerland

Sep. 2019 · **Topology seminar**, EPFL, Switzerland.
· **A distributive law for compact symmetric multicategories**.

Melbourne Univ. Vic.	*May 2019* · **Topology seminar**, Melbourne University, Vic. · **A new nerve theorem for compact symmetric multicategories**.
UL Bruxelles, Belgium	*Dec. 2018* · **Category theory seminar**, Université Libre de Bruxelles. · Invited talk: **Compact symmetric multicategories and loops**.
MATRIX Vic.	*June 2016* · Conference: **Higher structures in geometry and physics**, MATRIX Research Institute, Vic · **Hierarchical networks and coloured modular operads.**
MBI, Ohio State Columbus, USA	*March 2016* · Workshop on **Generalized Network Structures and Dynamics**, Mathematical Biosciences Institute, Ohio State University, Columbus, Ohio, USA. · Flash talk: **Hierarchical networks**.
Oxford University UK	*Oct. 2013* · Oxford junior topology and group theory seminar, Oxford University, UK. · Invited talk: **Learning spaces**.
Edinburgh Univ. UK	*June 2013* · Young Researchers in Mathematics, Edinburgh University, UK. · **A categorical description of neural networks**.
Leiden Univ. NL	*April 2005* Student functional analysis seminar, Leiden University, NL. · Expository talk: **Holomorphic functional calculus**.
Topology/Category Seminars	*2013-21* · Regular presentations for seminars at home institutions (**Australian Category Seminar**, **Aberdeen and EPFL Topology Seminar**s).

ADDITIONAL SELECTED RESEARCH VISITS, WORKSHOPS, AND CONFERENCES

Indigenising Mathematics	*20-21 Sept. 2021* · Wollotuka Institute, University of Newcastle, NSW · Conference on Indigenising university mathematics.
Women in geometry &c.	*20 Aug.-4 Sept. 2021* · MATRIX Research Institute, Victoria, Australia. · Invitation and funding offer, intensive research week. · **Women in geometry, analysis and topology**.
Quantum Hackathon	*24-27 Aug. 2021* · **EQUS, ARC centre of excellence Engineered Quantum Systems** at University of Queensland, & partners.
paraDIGMS 2021	*April 2021* · paraDIGMS 2021 Spring Conference, Institute for Mathematical and Statistical Innovation (IMSI), online. · **Diversity in graduate mathematical sciences**.
Oxford & EPFL, research visit	*Sept. 2019* · University of Oxford, UK. Guest of Prof. U. Tillmann, **Mathematical Institute**, and of Dr. J. Vicary, **Quantum Group, Computer Science**. · EPFL, CH. Guest of Prof. Kathryn Hess, **Institute of Mathematics** and **Blue Brain Project**.
Quantum Theory	*March 2018* · ICMS, Edinburgh, UK. · Multi-disciplinary workshop on **'combining viewpoints in quantum theory'**.
Women in Topology	*29 Nov. - 1 Dec. 2017* · MSRI, Berkeley, USA. · Intensive collaboration. · **'Direct proofs of properties and structures of model structures for $(\infty; 1)$-categories'**.
∞-Operads	*12 - 14 Jul. 2017* · Univ. Osnabrück, Germany. · Workshop on **∞-operads and applications**.
Higher Structures	*5- 17 June 2016* · MATRIX Research Institute, Victoria, Australia. · Workshop and conference on **higher structures in geometry and physics**.
Hochschild complexes	*12 - 16 Oct. 2015* · University of Copenhagen, Denmark. · Masterclass on **algebraic structures of Hochschild complexes**.
Applied Category Theory	*15 - 18 Sept. 2015* · EPFL, Switzerland. · Mini-course tutored by Dr. D. Spivak (MIT) on **Applied category theory: information structures and modular systems**.
Applied Topology	*2 - 6 Feb. 2015* · EPFL, Switzerland. · Mini-course tutored by Dr. P. Dlotko (Swansea University) on **Applied and computational topology**.
Atiyah 80	*20 - 22 April 2009* · Informatics Forum, Edinburgh, UK. · **Geometry and Physics**, 80th birthday conference for Sir Michael Atiyah.

EDUCATION/TEACHING INTERESTS

- Pure maths and applications thereof (e.g. basics of topological data analysis).

- Mathematical creativity. Existing and potential applications of 'pure' maths. Mathematical thinking: Formulating questions, proof and rigour, generalising results.

- Innovation and effective pedagogy for mathematics. Creative and sustainable approaches to STEM teacher shortage in regional schools. Indigenisation of curriculum.

- Obstacles to mathematical confidence and achievement (with a particular interest in the effect of racial, and socio-economic biases, and addressing 'saviourism').

- Retention of (marginalised) students, supporting different learners, outreach pitfalls.

ACADEMIC TEACHING

Undergraduate tutor	*Late 2019* · Macquarie University, AU. Workgroup tutor complex analysis and vector calculus.
Undergraduate tutor	*06-12/2018* · Rotterdam University of Applied Sciences (Hogeschool, Rotterdam), NL. · Principles of programming tutor, Computer Science degree.
Undergraduate tutor	*2003* · Mathematical Institute, Leiden University, NL. · Academic tutor, BSc students.

OTHER RELEVANT PAST EMPLOYMENT

Machine learning	*06-12/2018* · Hoppinger, Rotterdam, NL · **Machine learning developer**.
Own Business, Teaching	*2010-2012* · Yoga Maya, Rotterdam, NL. · (Co-)founder, manager, teacher. Co-founder, (joint) first traditional daily *Mysore-style* Astanga yoga programme in the Netherlands.
Mathematics Education	*2002-2005* · Vierkant voor Wiskunde, Leiden, NL. · **Project manager** developing materials for enhancing mathematics eduction in Dutch schools.
Educational Publishing	*2000-2001* · Cambridge Publishing Management, Cambridge, UK. · **Project editor** for school (mathematics) textbooks at publishing packager.
Academic Teaching Training	*2003* · ICLON, Graduate school of teaching, Leiden University · Academic teaching course.

ACADEMIC SERVICE

Neumann prize	*Dec 2020* · **AustMS 2020**, University of New England, online. · I served, by invitation, on the judging committee for the Australian Mathematical Society best (graduate) student talk of 2020.
Australian Category Seminar	*06/2019-10/2020* · Organiser · Australian Category Seminar.
Institute Council	*2002-2003* · Student member, council of the Mathematical Institute of the University of Leiden.
Women in Mathematics Day	*May 2021* · Talk for International Women in Mathematics Day, Macquarie. · **What about me? When DEI overlooks the very people it is created to help**.
Ally Network	LGBTIQ+ Ally, Macquarie University.

VARIOUS

Training	*2003* · ICLON, Graduate school of teaching, Leiden University · Academic teaching course.
Membership	· Australian Mathematical Society, Aboriginal and Torres Strait Islander Mathematics Alliance.
Languages	· Native English, fluent Dutch, school French and German.
Life Saving	· Australian Surf Life Saving. Patrolling member (BM, ARTC) Mona Vale, and Garie.
Other	· Fan of wilderness and getting lost. Occasional marathon runner. Food lover.