SOPHIE RAYNOR

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CURRENT EMPLOYMENT

Lecturer,
Mathematics

01/2022-   James Cook University, Australia.
College of Art, Society and Education, & College of Science and Engineering.

Post-doc,
Category theory

01/2019-21   Macquarie University, Australia.
Post-doctoral research fellow at **Centre of Australian Category Theory.**

EDUCATION

PhD,
Mathematics

2012-2018   University of Aberdeen, UK.
Title: **Compact symmetric multicategories and the problem of loops**
Funded by the **Blue Brain Project, EPFL, CH**.
Supervisors: R. Levi (University of Aberdeen) and K. Hess (EPFL, Switzerland).

BScMSc,
Mathematics

2002-2010   Leiden University, The Netherlands.
Cum Laude (First Class Honours)

BA Hons,
Philosophy

1997-2000   King's College, Cambridge University, UK.
(MA Cantab 2004.)

RESEARCH INTERESTS

- The combinatorics of duality, genus and units. Modular operads and diagram categories.

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

- Generalised operad theory. Geometric and algebraic approaches to higher structures.

- Fundamental mathematics and real-world challenges. Applications of (modular) operads in computer science and data science.

PUBLICATIONS

· In pure mathematics, collaborations are listed alphabetically, and authors credited equally.
· Relative to other sciences, publication rates in pure mathematics are low and refereeing times are long.

Topology and its
Applications

· *An infinity operad of normalized cacti.*
Together with L. Bonatto, S. Chettih, A. Linton, M. Robertson and N. Wahl. *Topology and its Applications*, Volume 316, July 2022. 54 pages.

Advances in
Mathematics

· *Graphical combinatorics and a distributive law for modular operads.*
Sole author. *Advances in Mathematics*, Volume 392, December 2021. 87 pages.

PREPRINTS / NEAR COMPLETION.

Expected 2022 · *Brauer diagrams, modular operads, and a graphical nerve theorem for circuit algebras.*
ArXiv preprint at arXiv:2108.04557.

Expected, 2022. · *Modular operads, and a graphical calculus and nerve for compact closed categories*

(IN PREPARATION.)

· *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.

n-CATEGORY CAFÉ BLOG POST

July 2018 · *Beyond Classical Bayesian Networks.*
With Pablo Andrez Martinez, blog post at The *n*-Category Café.

INVITED TALKS (INTERNATIONAL)

BGSU & *April 2022* · Algebra seminar, **Bowling Green State University & University of Toledo**, Ohio.
U. Toledo, USA · **Modular operads, loops, nerves and distributive laws**.

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

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

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

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

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

Scot. Topology *Sept. 2013* · **Glasgow University, UK**, Scottish Topology Seminar.
Glasgow, UK · **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 *Dec 2020* · **Conference of the Australian Mathematics Society**, University of New England,
Online NSW, online. · **An operadic view of compact closed categories**.

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

Melbourne Univ. *May 2019* · **Topology seminar**, Melbourne University, Vic.
Vic. · **A new nerve theorem for compact symmetric multicategories**.

UL Bruxelles, *Dec. 2018* · **Category theory seminar**, Université Libre de Bruxelles.
Belgium · Invited talk: **Compact symmetric multicategories and loops**.

MATRIX *June 2016* · Conference: **Higher structures in geometry and physics**, MATRIX Research
Vic. 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

- Subject expertise in 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.

- Obstacles to mathematical confidence and achievement. Retention of (marginalised) students, supporting different learners, outreach pitfalls.

ACADEMIC TEACHING

Lecturer, Subject coord	*2022* · Discrete Mathematics.
Lecturer, Subject coord	*2022* · Preparatory Mathematics.
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** at full service IT agency.
Own Business, Teaching	*2010-2012* · Yoga Maya, Rotterdam, NL. · I (co-)founded, managed, and taught at a successful yoga studio in Rotterdam (including the first traditional daily *Mysore-style* 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.
Private tutoring	*1992-1998* · Private tutor and class assistant, school students struggling with STEM subjects.

VOCATIONAL TRAINING

Academic Teaching Training	*2003* · ICLON, Leiden University, NL. · Academic teaching course at Leiden University Graduate School of Teaching (ICLON).
Mapper software Ayasdi	*2012* · Online (EPFL/California) · principals of Mapper software and data analysis.

ACADEMIC SERVICE

Neumann committee	*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. This is one of the longest running, and most highly regarded, weekly specialist mathematics seminars in the world. I prioritised junior participation, and oversaw the transition to an online setting.
Institute Council	*2002-2003* · Student member of the *instituutsraad*, the council of the Mathematical Institute of the University of Leiden.
Women in Mathematics Day	*May 2021* · I was asked to speak 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.