Emily Riehl

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RESEARCH INTERESTS

Topics in category theory related to homotopy theory: e.g., ∞-categories, (∞, n)-categories, model categories, weak factorization systems, the small object argument, homotopy type theory, simplicial categories, simplicial sets, derived functors, functor calculus, Reedy categories, and multivariable adjunctions and mates.

ACADEMIC POSITIONS

Johns Hopkins University, Baltimore, MD

Assistant Professor, July 2015–present

Harvard University, Cambridge, MA

Benjamin Peirce Postdoctoral Fellow and NSF Postdoctoral Fellow, July 2011–June 2015

VISITING POSITIONS

Centre for Advanced Study, Norwegian Academy of Science and Letters, Oslo, Norway

Fellow, May–June 2019

Centre of Australian Category Theory, Sydney, Australia

Visitor, January–July 2017

Max Planck Institute for Mathematics, Bonn, Germany

"Higher structures in Geometry and Physics" Program Participant, January 2016

Hausdorff Research Institute for Mathematics, Bonn, Germany

"Homotopy theory, manifolds, and field theories" Program Participant, May–June 2015

Mathematical Sciences Research Institute, Berkeley, CA

Research Member, January–May 2014

EDUCATION

University of Chicago, Chicago, IL

Ph.D. in Mathematics, June 2011; M.A. in Mathematics, June 2009
- Thesis: "Algebraic model structures" advised by J. Peter May.

University of Cambridge, Churchill College, Cambridge, UK

Certificate of Advanced Study in Mathematics (Part III) with Distinction, June 2007
- Essay: "Higher category theory" advised by Martin Hyland.

Harvard University, Cambridge, MA

A.B. Mathematics, *magna cum laude*, June 2006
- Thesis: "Lubin-Tate formal groups and local class field theory" advised by Frank Calegari.

AWARDS

Johns Hopkins Catalyst Award, 2018–2019.

Joel Dean Award for excellence in teaching, 2017.

Principal Investigator, "Model-Independent Foundations for Higher ∞-Categories," National Science Foundation CAREER Grant DMS-1652600, 2017–2022

Simons Visiting Professorship at Oberwolfach, 2016

Principal Investigator, "Reimagining the Foundations of Infinite Dimensional Category Theory," National Science Foundation Grant DMS-1551129, 2015–2018

Harvard University Certificate of Teaching Excellence, 2014, 2015

AMS-Simons Travel Grant, 2014

National Science Foundation Mathematical Sciences Postdoctoral Research Fellowship, 2011–2014

National Science Foundation Graduate Research Fellowship, 2006–2011

Churchill Scholarship, The Winston Churchill Foundation of the United States, 2006

Barry M. Goldwater Scholarship, 2005

Harvard University Certificate of Distinction in Teaching, 2004, 2005, 2006

3rd Place in Intel Science Talent Search, 2002

Books
E. Riehl, *Category Theory in Context*, Aurora: Modern Math Originals, Dover Publications, 2016, xvii+240 pp. also available from www.math.jhu.edu/~eriehl/context.pdf

E. Riehl, *Categorical Homotopy Theory*, New Mathematical Monographs, 24. Cambridge University Press, 2014, xviii+352 pp. also available from www.math.jhu.edu/~eriehl/cathtpy.pdf

Publications
E. Riehl and D. Verity, *The comprehension construction*, to appear in Higher Structures (2017), 1–76, arXiv:1706.10023

K. Bauer, B. Johnson, C. Osborne, E. Riehl, and A. Tebbe, *Directional derivatives and higher order chain rules for abelian functor calculus*, Topology Appl. Women in Topology II: Further collaborations in homotopy theory **253** (2018), 375–427, arXiv:1610.01930

E. Riehl and M. Shulman, *A type theory for synthetic ∞-categories*, Higher Structures **1** (2017), no. 1, 116–193, arXiv:1705.07442

K. Hess, M. Kędziorek, E. Riehl, and B. Shipley, *A necessary and sufficient condition for induced model structures*, J. Topology **10** (2017), no. 2, 324–367, arXiv:1509.08154

E. Riehl and D. Verity, *Kan extensions and the calculus of modules for ∞-categories*, Algebr. Geom. Topol. **17** (2017), no. 1, 189–271, arXiv:1507.01460

E. Riehl and D. Verity, *Fibrations and Yoneda's lemma in an ∞-cosmos*, J. Pure Appl. Algebra **221** (2017), no. 3, 499–564, arXiv:1506.05500

M. Ching and E. Riehl, *Coalgebraic models for combinatorial model categories*, Homol. Homotopy Appl. **16** (2014), no. 2, 171–184, arXiv:1403.5303

E. Riehl and D. Verity, *Completeness results for quasi-categories of algebras, homotopy limits, and related general constructions*, Homol. Homotopy Appl. **17** (2015), no. 1, 1–33, arXiv:1401.6247

M. Bayeh, K. Hess, V. Karpova, M. Kędziorek, E. Riehl, and B. Shipley, *Left-induced model structures and diagram categories*, Contemp. Math. **641** (2015), 49–81. arXiv:1401.3651

E. Riehl and D. Verity, *Homotopy coherent adjunctions and the formal theory of monads*, Adv. Math **286**

(2016), 802–888, arXiv:1310.8279

T. Barthel, J.P. May, and E. Riehl, *Six model structures for DG-modules over DGAs: model category theory in homological action*, New York J. Math **20** (2014), 1077-1159, arXiv:1310.1159

E. Riehl and D. Verity, *The 2-category theory of quasi-categories*, Adv. Math. **280** (2015), 549–642, arXiv:1306.5144

E. Riehl and D. Verity, *The theory and practice of Reedy categories*, Theory Appl. Categ. **29** (2014), no. 9, 256–301, arXiv:1304.6871

E. Cheng, N. Gurski, and E. Riehl, *Cyclic multicategories, multivariable adjunctions and mates*, J. K-theory **13** (2014), no. 2, 337–396, arXiv:1208.4520

A.J. Blumberg and E. Riehl, *Homotopical resolutions associated to deformable adjunctions*, Algebr. Geom. Topol. **14** (2014), no. 5, 3021–3048, arXiv:1208.2844

T. Barthel and E. Riehl, *On the construction of functorial factorizations for model categories*, Algebr. Geom. Topol. **13** (2013), no. 2, 1089–1124, arXiv:1204.5427

E. Riehl, *Monoidal algebraic model structures*, J. Pure Appl. Algebra **217** (2013), no. 6, 1069–1104, [arXiv:-1109.2883](arXiv:1109.2883)

C. Kennett, E. Riehl, M. Roy, M. Zaks, *Levels in the toposes of simplicial sets and cubical sets*, J. Pure and Appl. Algebra **215** (2011), no. 5, 949–961, arXiv:1003.5944

E. Riehl, *On the structure of simplicial categories associated to quasi-categories*, Math. Proc. Camb. Phil. Soc. **150** (2011), no.3., 489–504, arXiv:0912.4809

E. Riehl, *Algebraic model structures*, New York J. Math. **17** (2011), 173–231, arXiv:0910.2733

J. D'Angelo, S. Kos, E. Riehl, *A Sharp Bound for the Degree of Proper Monomial Mappings Between Balls*, J. Geom. Anal. **13** (2003), no. 4, 581–593.

E. Graham Evans, Jr. and E. Riehl, *On the intersections of polynomials and the Cayley-Bacharach theorem*, J. Pure and Appl. Algebra **183** (2003), no. 1–3, 293–298.

PREPRINTS

E. Riehl and D. Verity, *On the construction of limits and colimits in ∞-categories*, (2018), 1–65, arXiv:1808.09835

E. Riehl and D. Verity, *Recognizing quasi-categorical limits and colimits in homotopy coherent nerves*, (2018), 1–51, arXiv:1808.09834

R. Garner, M. Kędziorek, and E. Riehl, *Lifting accessible model structures*, (2018), 1–18, arXiv:1802.09889

F. Loregian and E. Riehl, *Categorical notions of fibration*, (2018), 1–17, arXiv:1806.06129

E. Riehl, *Homotopy coherent structures*, (2017), 1–26, arXiv:1801.07404

E. Riehl and D. Verity, *∞-category theory from scratch*, (2015), 1–53, arXiv:1608.05314

TEACHING

Johns Hopkins University, Baltimore, MD

Instructor in Mathematics, 2015–present
- *Category Theory in Context* — a graduate-level topics course
- *Algebraic Topology II* — a graduate-level course

- *Calculus III* — an undergraduate-level course (twice)
- *Algebra I* — a graduate-level course
- *Honors Algebra I* — an undergraduate-level course
- *The model-independent theory of ∞-categories* — a graduate-level topics course

Masters Thesis Advisor, 2016

- Lyne Moser "Derivators and basic localizers"

Harvard University, Cambridge, MA

Instructor in Mathematics, 2012–2015

- *Categorical Homotopy Theory* — a graduate-level topics course
- *Topology I* — an undergraduate-level course (twice)
- *Fun and Games with Discrete Mathematics* — a one-week "Wintersession" course
- *Introduction to Mathematical Logic* — an undergraduate-level course
- *Category Theory in Context* — an undergraduate-level topics course

Faculty Supervisor in Mathematics, 2012–2015

- Undergraduate senior thesis project by Marina Lehner "All Concepts are Kan Extensions"
- Undergraduate reading courses in category theory, simplicial homotopy theory, quasi-category theory, higher category theory, and topos theory.

Teaching Fellow in Mathematics, 2011

- *Multivariable Calculus*

University of Chicago, Chicago, IL

Directed Reading Program, mentor for undergraduates, 2008–2010

- Projects involving category theory and knot theory

Research Experience for Undergraduates, mentor, 2008–2010

- Projects involving topics in algebraic topology, category theory, and number theory

College Fellow in Mathematics, 2008–2009

- *Elementary Number Theory*, mentor: J. Boller
- *Basic Geometry*, mentor: D. Hermann
- *Introduction to Algebraic Topology*, mentor: T. Fiore

SELECTED LECTURES

Vladimir Voevodsky Memorial Conference, "The synthetic theory of ∞-categories vs the synthetic theory of ∞-categories," Institute for Advanced Study, September 2018.

Invited Paper Session "Category theory for all" at the MAA Math Fest, "Categorifying cardinal arithmetic," Denver, August, 2018.

Higher-Dimensional Rewriting and Algebra, Federated Logic Conference 2018, "Homotopy coherent adjunctions and other structures," July 2018.

Higher structures in homotopy theory, Isaac Newton Institute for Mathematical Sciences, invited lecture series, "The model-independent theory of $(\infty, 1)$-categories," Cambridge, UK, July 2018.

Joint International Meeting of the American Mathematical Society and Chinese Mathematical So-

ciety, "A model-independent theory of ∞-categories," Shanghai, June, 2018.

Infinity-Categories, Infinity-Operads, and their Applications Workshop, "A proof of the model-independence of ∞-category theory," Casa Matemática Oaxaca, May, 2018.

Keynote lecture, Women in Math and Statistics Conference, Harvard University, "Categorifying Cardinal Arithmetic," April, 2018.

University of Washington Colloquium, "Applications of functoriality," April 2018.

Keynote lecture, 43rd Annual New York Regional Graduate Mathematics Conference, Syracuse University, "What is a universal property?," March 2018.

Homotopy Type Theory Electronic Seminar Talks, "The synthetic theory of ∞-categories vs the synthetic theory of ∞-categories," March 2018.

ASL Invited Address, Joint Mathematics Meetings, "A synthetic theory of ∞-categories in homotopy type theory," January 2018.

Homotopy Type Theory Special Session, Joint Mathematics Meetings, "On the directed univalence axiom," January 2018.

Women in Topology Workshop, MSRI, "Foundations of $(\infty, 2)$-category theory," November, 2017.

University of Illinois Urbana-Champaign Colloquium, "Applications of functoriality," November 2017.

Reed College Colloquium, "Homotopy types as a foundation for mathematics," October 2017.

University of Western Ontario Colloquium, "Applications of functoriality," September 2017.

Colloquium lecture for the Women in Maths special interest group of the Australian Maths society, "On women in topology and abelian functor calculus," July 2017.

Floer homology and homotopy theory summer school, mini course, "Homotopy coherent structures," UCLA, July 2017.

Compose Conference, New York, "A categorical view of computational effects," May 2017.

Macquarie University Colloquium, "Functoriality in algebra and topology," March 2017.

Women, Gender, and Sexuality Graduate Colloquium and Lecture Series, "Can mathematical proof inform queer epistemology?" Johns Hopkins University, October 2016.

Topology of manifolds: a conference in honour of Michael Weiss' 60th birthday, "Homology without simplices," University of Lisbon, June 2016.

Johns Hopkins Applied Physics Laboratory Colloquium, "A solution to the stable marriage problem," June 2016.

Higher Structures in Geometry and Physics Workshop, Invited lecture series, "Weak complicial sets," MATRIX, Melbourne, June 2016.

Homotopy Type Theory and Univalent Foundations Workshop, "Towards a synthetic theory of $(\infty, 1)$- categories," Fields Institute, Toronto, May 2016.

Midwest Topology Seminar, Ohio State University, "Model-independent ∞-category theory in the homotopy 2-category," May 2016.

Higher structures in Geometry and Physics Opening Conference, Max Planck Institute for Mathe-

matics, Bonn, "On model-comparison results for ∞-categories," January 2016.

Workshop on category theory and algebraic topology, Université catholique de Louvain, "Model-independent ∞-category theory in the homotopy 2-category," September 2015.

Young Topologists Meeting, EPFL Lausanne, Invited lecture series, "∞-category theory from scratch," July 2015.

Texas Undergraduate Topology and Geometry Conference, UT Austin, "Self-similiar spaces," February 2015.

Indiana University Colloquium, "On the duality between 'free' and 'forgetful' constructions," January 2015.

University of Virginia Colloquium, "On the duality between 'free' and 'forgetful' constructions," January 2015.

Notre Dame Colloquium, "On the duality between 'free' and 'forgetful' constructions," January 2015.

UCLA Colloquium, "On the duality between 'free' and 'forgetful' constructions," January 2015.

Johns Hopkins University Colloquium, "On the duality between 'free' and 'forgetful' constructions," December 2014.

Boston College Colloquium, "On the duality between 'free' and 'forgetful' constructions," November 2014.

Cornell University Oliver Club Colloquium, "On the duality between 'free' and 'forgetful' constructions," November 2014.

Topologie workshop, Mathematisches Forschungsinstitut Oberwolfach, "Toward the formal theory of (∞, n)-categories," September 2014.

Institute for Basic Science, Center for Geometry and Physics, Pohang, Korea, "A universal approach to universal algebra," August 2014.

Days of the Federation de Recherche en Mathématiques de Paris Centre, Institute Henri Poincaré, "The formal theory of adjunctions, monads, algebras, and descent," June 2014.

Reimagining the Foundations of Algebraic Topology, MSRI, "The formal theory of adjunctions, monads, algebras, and descent," April 2014.

Graduate Student Topology and Geometry Conference, Young Faculty Speaker, "Quasi-category theory you can use," University of Texas at Austin, April 2014.

Committee of Academic Sponsors Postdoc Talk, MSRI, "Categorical definitions in algebraic topology," February 2014.

AMS Special Session on Homotopy Theory, "Homotopy coherent adjunctions," January 2014.

Wesleyan University Colloquium, "Homotopy coherent adjunctions," November 2013.

Conference on Type Theory, Homotopy Theory, and Univalent Foundations, Centre de Recerca Mathemàtica, "Made-to-order weak factorization systems," September 2013.

International Category Theory Conference, "The formal theory of homotopy coherent monads," July 2013.

Special Session on Progress in Higher Categories, CMS Summer Meeting, Halifax, "The formal cat-

egory theory of quasi-categories," June 2013.

Informal Dynamics and Geometry Seminar, PechaKucha: Mathematics 20x20, Harvard University, "A solution to the stable marriage problem," March 2013.

Workshop on Higher Dimensional Algebra, Categories and Types, University of Ljubljana, "Homotopy coherent adjunctions of ∞-categories," June 2012.

Friends of Mathematics Junior Faculty Lecture, "The algebra and geometry of ∞-categories," May 2012.

Midwest Topology Seminar, Northwestern University, "Lifting properties and the small object argument," March 2012.

Special Session on Homotopy Theory and Its Applications, Association for Women in Mathematics 40th Anniversary Conference, "Algebraic model structures," September 2011.

Special Session on Homotopy and Categories, CMS Summer Meeting, Edmonton, "Algebraic model structures," June 2011.

University of Sheffield, Invited seminar series, "Algebraic model structures and cellularity," April 11-14, 2011.

Friends of Mathematics Lecture and Honoraria, "Lubin-Tate formal groups and local class field theory," Harvard University, April 2006.

University of Illinois at Urbana-Champaign, "On the properties of Tits graphs," August 2002.

Selected Service	**Co-Organizer** for a MSRI semester program "Higher categories and categorification," 2020. **Co-Organizer** of the Mathematics Research Community on Homotopy Type Theory, 2017. **Co-Organizer** of the Mid-Atlantic Topology Conference and Co-PI for the associated NSF grant DMS-1619569, 2016.

Co-Mentor for the 2018 MIT Talbot Workshop: the model-independent theory of ∞-categories. **Organizer** of the Kan Extension Seminar, an online graduate reading course in category theory, 2014, 2017. **Co-Host** of the *n*-Category Café, 2013-present.

Member of NSF review panels for the Division of Mathematical Sciences; **Member** of the AMS University Lecture Series Editorial Committee, 2019–2023; **Member** of the AMS Web Editorial Group, 2015–2017 (chair 2017); **Member** of the AMS Mathematics Research Communities Advisory Board, 2017–2020; **Member** of the Scientific Committee for the International Category Theory conference, 2016, 2018. **Member** of the Churchill Scholarship Screening Committee, 2014.

Editor for Journal of Homotopy and Related Structures (2016-present), Homology, Homotopy, and Applications (2015-present), and Cahiers de Topologie et Géométrie Différentielle Catégoriques (2014-present). **Referee** for Advances in Mathematics, Algebraic and Geometric Topology, American Mathematical Monthly, Annals of Mathematics, Applied Categorical Structures, Forum Mathematicum, Geometry and Topology, Journal of the European Mathematical Society, Journal of Pure and Applied Algebra, Mathematical Structures in Computer Science, Mathematische Zeitschrift, New York Journal of Mathematics, Theory and Applications of Categories, and Transactions of the AMS.

Member of the Qualifying Exams Committee 2011, the Colloquium Committee 2012, and the Graduate Admissions Committee 2015; Junior **Advisor** 2012-2013; Undergraduate Thesis **Supervisor** 2013-2014; **Assistant Director of Graduate Studies** 2014-2015 at Harvard. **Diversity Champion** for the mathematics department at Johns Hopkins 2015-present.