Sean Tull - Curriculum Vitae

Personal details

- Nationality: British
- Date of Birth: 9th November 1990
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  Oxford, OX1 2LZ.

Research interests I am a researcher in applied category theory. I have used categories to study quantum theory and more general theories of physical processes, including:

- reconstructions of quantum theory from simple categorical principles (see papers [3, 4, 5] below);
- formalisations of operational physical theories [8,9,13,14] and quantum protocols [12];
- categorical models of spatiality and causality [7,10].

I am also interested in pure category theory [6,11]. More recently I am studying categorical approaches to natural language processing, cognition and consciousness [1, 2].

Education

Oct. 2014 - *June 2018.*	**DPhil student in Computer Science, St. Catherine's College, University of Oxford.** Thesis title: *Categorical Operational Physics.* Supervisors: Bob Coecke (Oxford) and Chris Heunen (Edinburgh). Thesis explores connections between general probabilistic theories and categorical quantum mechanics. Includes a categorical reconstruction of finite-dimensional quantum theory. Presentations on research given at numerous conferences and workshops. Supported by EPSRC Studentship.
Oct. 2009 - *June 2013.*	**MMath and BA in Mathematics, Selwyn College, University of Cambridge.** First Class in all BA years. Distinction in MMath with 91% marks, placing 11th in year of 226. Final year courses include category theory, computability and logic, quantum foundations. Master's essay on *Locally Presentable and Accessible Categories* awarded distinction level. BA courses include quantum mechanics, general relativity and logic and set theory.
Sep. 2002 - *June 2009.*	**John Kyrle High School, and Hereford Sixth Form College.** 5 A-Levels including Mathematics, Further Mathematics and Physics. Advanced Extension Award in Mathematics: Distinction. Grade 1 in STEP Exams in Mathematics Papers II and III. 11 GCSEs with 10 A* grades and 1 A. GNVQ ICT at Distinction level.

Employment

Dec. 2019 - *Present*	**Researcher, Cambridge Quantum Computing and Topos Institute, Oxford.** Research position in quantum natural language processing at Oxford branch of Cambridge Quantum Computing, co-located with the Topos Institute for applied category theory.
Nov. 2018 - *July 2019*	**Researcher, Department of Computer Science, University of Oxford.** Postdoctoral position in categorical quantum mechanics, as recipient of EPSRC Doctoral Prize.
Aug. - *Oct. 2018.*	**Research assistant, School of Informatics, University of Edinburgh.** Research on mathematical approaches to quantum foundations, focusing on spatial aspects of monoidal categories. Employed through Dr Chris Heunen's EPSRC project 'Combining viewpoints in quantum theory'.

Teaching experience

Oct. - Dec. 2015 **Tutor in *Categories, Proofs and Processes*, University of Oxford**
Gave tutorial classes for around 10 Msc students in the Department of Computer Science, discussing course material and example problems.
Marked students weekly assignments and graded students for overall performance in tutorials.

Nov. - Dec. 2018 **Tutor in *Quantum Computer Science*, Oxford Programme for Undergraduate Studies**
Taught an undergraduate visiting student in Oxford.
Created and structured a course on quantum computing based on students interests.
Marked and discussed assignments in weekly tutorials.

Dec. 2018 - Present ***The Profs* Tutoring agency**
One-to-one tutoring in mathematics and computer science through private tutoring agency.
Structuring course content, teaching, and testing understanding through exercises.
Over 200 hours of one-to-one tutoring time, with students from Foundation to PhD level.
Students include undergraduates in mathematics and computer science, a master's student in data analytics, and a PhD student in physics.

Prizes

- EPSRC Doctoral Prize, 2018. Supports a postdoctoral research position to enhance DPhil work. Aimed at top 10-15% of graduating EPSRC funded doctoral students.
- Searle prize for mathematics at Selwyn College: 2010, 2011, 2013.
- Selwyn college prize, election and re-election to a college scholarship: 2010, 2011, 2012, 2013.

Seminars and conference presentations

- Models of Consciousness Conference, Mathematical Institute, University of Oxford, 09/09/19.
- Quantum Physics and Logic Conference, Chapman University California, 14/06/19.
- Symposium on Compositional Structures, University of Strathclyde, Glasgow, 17/12/18.
- Conference, 6th World Congress of Universal Logic, Vichy, 23/06/18.
- Quantum Physics and Logic XV Conference, Dalhousie University, 07/06/18.
- Quantum Physics and Logic XIV Conference, Radboud University Nijmegen, 05/07/17.
- Computing Institute Seminar, Radboud University Nijmegen, 01/03/17.
- Foundations of Physics 2016 Conference, London School of Economics, 18/07/16.
- Quantum Information Theory Seminar, Pavia University, 28/06/16.
- Quantum Physics and Logic XIII Conference, University of Strathclyde, 09/06/16.
- Categories, Logic and Physics Workshop, University of Edinburgh, 14/04/16.
- Causality in Quantum Foundations Workshop, Bellairs Research Institute, Barbados, 17/03/16.
- UCL-ULB-VUB Category Theory Seminar, Free University Brussels, 25/01/16.
- Computing Institute, Radboud University Nijmegen, 16/09/15.
- Quantum Physics and Logic XII Conference, University of Oxford, 17/07/15.

Research visits

- Department of Mathematics, Université Catholique de Louvain, Belgium: 1 week, November 2017.
- Computing Institute, Radboud University Nijmegen, Netherlands: 1 week, March 2017.
- Quantum Information Theory Group, University of Pavia, Italy: 1 week, June 2016.
- Department of Mathematics, Université Catholique de Louvain, Belgium: 1 week, December 2016.
- Causality in Quantum Foundations Workshop, Bellairs Research Institute, Barbados: 1 week, March 2016.
- Department of Mathematics, Université Catholique de Louvain, Belgium: 1 week, January 2016.
- Computing Institute, Radboud University Nijmegen, Netherlands: 1 week, September 2015.

Reviewing services

- Programme committee member of the 4th *Symposium on Compositional Structures*.
- Selected to review articles for the *Journal of Logical and Algebraic Methods in Programming*, the journals *Communications in Algebra*, *Quantum*, and *Compositionality*, and the conferences *Foundations of Software Science and Computation Structures* and *Mathematical Foundations of Programming Semantics*.

Organisation I co-organise the 2020 online seminar series *Mathematical Consciousness Science*. I also co-organised the workshop *Modelling Consciousness* to be held in Dorfgastein, Austria in March 2020, which was held online following the pandemic.

Five publications relevant to the application

1. Johannes Kleiner and Sean Tull. *The Mathematical Structure of Integrated Information Theory*. Pre-print available at `https://jkleiner.de/uploads/IITMath.pdf`. 2020. (Featured as a cover story in *New Scientist*, May 2nd 2020, available here).

2. Sean Tull and Johannes Kleiner. *Integrated Information in Process Theories*. Pre-print available at `https://jkleiner.de/uploads/IITProcess.pdf`. 2020. Submitted to *Semantic Spaces at the Intersection of NLP, Physics, and Cognitive Science*. 2020.

3. Sean Tull. *Monoidal Categories for Formal Concept Analysis*. Pre-print. Submitted to *Semantic Spaces at the Intersection of NLP, Physics, and Cognitive Science*. 2020.

4. Sean Tull. *A Categorical Reconstruction of Quantum Theory*. In *Logical Methods in Computer Science*. 2020.

5. Bob Coecke, John Selby and Sean Tull. *Two Roads to Classicality*. In the Proceedings of the 14th International Conference on Quantum Physics and Logic. Vol. 266 of *Electronic Proceedings in Theoretical Computer Science*, p. 104-118. 2017.

Five other representative publications

1. Sean Tull. *Categorical Operational Physics*. DPhil Thesis, University of Oxford. 2018.

2. Sean Tull. *Deriving Dagger Compactness*. Proceedings of the 16th International Conference on Quantum Physics and Logic, in *Electronic Proceedings in Theoretical Computer Science*. 2019.

3. Sean Tull. *Quotient Categories and Phases*. In *Theory and Application of Categories*. 2019.

4. Pau Enrique Moliner, Chris Heunen and Sean Tull. *Tensor Topology*. In the *Journal of Pure and Applied Algebra*. 2020.

5. Chris Heunen and Sean Tull. *Categories of relations as models of quantum theory*. In the Proceedings of the 12th International Conference on Quantum Physics and Logic. Vol. 195 of *Electronic Proceedings in Theoretical Computer Science*, p. 247-261. 2015.

Full publication list

1. Johannes Kleiner and Sean Tull. *The Mathematical Structure of Integrated Information Theory*. Pre-print available at `https://jkleiner.de/uploads/IITMath.pdf`. 2020.

2. Sean Tull and Johannes Kleiner. *Integrated Information in Process Theories*. Pre-print available at `https://jkleiner.de/uploads/IITProcess.pdf`. 2020.

3. Sean Tull. *A Categorical Reconstruction of Quantum Theory*. In *Logical Methods in Computer Science*. 2020.

4. Sean Tull. *Quotient Categories and Phases*. In *Theory and Application of Categories*. 2019.

5. Sean Tull. *Deriving Dagger Compactness*. To appear in the proceedings of the 16th International Conference on Quantum Physics and Logic, in *Electronic Proceedings in Theoretical Computer Science*. 2019.

6. Marino Gran, Chris Heunen and Sean Tull. *Monoidal characterisation of groupoids and connectors*. In *Topology and its Applications*. 2019.

7. Pau Enrique Moliner, Chris Heunen and Sean Tull. *Tensor Topology*. In the *Journal of Pure and Applied Algebra*. 2020.

8. Sean Tull. *Categorical Operational Physics*. DPhil Thesis, University of Oxford. 2018.

9. Bob Coecke, John Selby and Sean Tull. *Two Roads to Classicality*. In the Proceedings of the 14th International Conference on Quantum Physics and Logic. Vol. 266 of *Electronic Proceedings in Theoretical Computer Science*, p. 104-118. 2017.

10. Pau Enrique Moliner, Chris Heunen and Sean Tull. *Space in Monoidal Categories*. In the Proceedings of the 14th International Conference on Quantum Physics and Logic. Vol. 266 of *Electronic Proceedings in Theoretical Computer Science*, p. 399-410. 2017.

11. Sean Tull. *Condition for an n-permutable category to be Mal'tsev*. Vol. LVIII-3&4 of *Cahiers de Topologie et Geometrie Differentielle Categoriques*, p. 189-194. 2017.

12. Aleks Kissinger, Sean Tull and Bas Westerbaan. *Picture-Perfect Quantum Key Distribution*. Pre-print at `arxiv.org/abs/1704.08668`. Presented at QPL 2017 conference. 2017.

13. Sean Tull. *Operational Theories of Physics as Categories*. Pre-print at `arxiv.org/abs/1602.06284`. Presented at QPL 2016 conference. 2016.

14. Chris Heunen and Sean Tull. *Categories of relations as models of quantum theory*. In the Proceedings of the 12th International Conference on Quantum Physics and Logic. Vol. 195 of *Electronic Proceedings in Theoretical Computer Science*, p. 247-261. 2015.

Other employment *Software Developer* for music technology start-up *Jukedeck* in London. Programmed in C++, Ruby and Python. August 2013-2014.