

Emma K. Towlson

Department of Computer Science, University of Calgary
602 ICT Building, 2500 University Drive NW
Calgary, Alberta, T2N 1N4, Canada
+1 (403) 220 8600
ektowlson@gmail.com
<https://emmatowlson.github.io/>

EMPLOYMENT	Assistant Professor, Network (Neuro)Science Department of Computer Science, University of Calgary Complexity Science Group, Department of Physics and Astronomy Hotchkiss Brain Institute	Jun. 2020 - present
	Research Affiliate Massachusetts Institute of Technology P.I.: Prof. Ed Boyden	Apr. 2018 - present
	Associate Research Scientist Part-time Lecturer Postdoctoral Research Associate CCNR, Northeastern University (NEU) P.I.: Prof. Albert-László Barabási	Jan. 2018 - Aug. 2020 Sep. 2016 - Sep. 2019 Apr. 2015 - Jan. 2018
EDUCATION	PhD Physics, Network Science University of Cambridge. Cavendish Laboratory (Theory of Condensed Matter (TCM) Group) and Girton College. Supervisor: Dr. Sebastian Ahnert Collaborating with Prof. Ed Bullmore and the Brain Mapping Unit (BMU) Funded by the Engineering and Physical Sciences Research Council (EPSRC) Associate member of the Institute of Physics TCM graduate representative	Oct. 2011 - Mar. 2015
	MMathPhys (First Class Honours) University of Warwick 4th Year project “Superfluidity in Strongly Coupled Light-Matter Systems” Supervisor: Dr. Marzena Szymanska	Oct. 2007 - Jun. 2011
	Undergraduate Research Scholarship Scheme (URSS) University of Warwick Supervisor: Prof. Sandra Chapman	Jul. 2010 - Sep. 2010
FUNDING & AWARDS	NSF NCS-FO: Collaborative Research \$237,499 over 2 years (of the \$707,296 total awarded to four groups). Title: Ground-Truth Analysis and Modeling of Entire Individual <i>C. elegans</i> Nervous Systems P.I.s: Prof. Edward Boyden (MIT), Prof. Albert-László Barabási (NEU), Prof. Max Tegmark (MIT), and Prof. Steven Flavell (MIT). Responsible for the BarabásiLab component of the grant, both in terms of writing the proposal and carrying out the research given its success.	Oct. 2017

Network Neuroscience Satellite Jun. 2017
James S. McDonnell Foundation (JSMF) sponsored \$20,000.

EPSRC Scholarship 2011
Awarded for research proposal for graduate study at the University of Cambridge.

Warwick Postgraduate Research Scholarship (WPRS) 2011
Selected for a prestigious scholarship for further study at the University of Warwick, one of around 15 available university wide.

Undergraduate Research Scholarship Scheme (URSS) 2010
Awarded £1000 for summer research proposal at the University of Warwick.

PROFESSIONAL Homeward Bound Nov. 2018 - Dec. 2019
DEVELOPMENT Selected as one of 95 women to be part of the 4th cohort of Homeward Bound: a ground-breaking leadership initiative, set against the backdrop of Antarctica, which aims to heighten the influence and impact of women in making decisions that shape our planet. The 10-year vision is to create a 1000-strong network of women scientists, ready and able to exert their influence on global policy. Engaging with a year-long leadership program, conducted remotely and culminating in a 3-week Antarctic voyage in Dec. 2019.

PUBLICATIONS Multi-Subject Stochastic Blockmodels for Adaptive Analysis of Individual Differences in Human Brain Network Cluster Structure
Dragana M. Pavlović, Bryan Guillaume, [Emma K. Towlson](#), Soroosh Afyouni, Petra E. Vértés, Thomas Yeo, Edward T. Bullmore, and Thomas E. Nichols. *NeuroImage*, 2020, 116611.

Synthetic ablations in the *C. elegans* nervous system
[Emma K. Towlson](#) and Albert-László Barabási. *Network Neuroscience*, 2020, 4(1).

The final frontier in connectomics: Forward engineering brain networks: Comment on “What would a synthetic connectome look like?” by Ithai Rabinowitch
[Emma K. Towlson](#). *Physics of Life Reviews*, 2019.

Brain Networks Reveal the Effects of Antipsychotic Drugs on Schizophrenia Patients and Controls
[Emma K. Towlson](#), Petra E. Vértés, Ulrich Müller, and Sebastian E. Ahnert. *Frontiers in Psychiatry*, 2019, 10: 611.

Effect of antipsychotics on the community structure of brain functional networks
Ryan Flanagan, Lucas Lacasa, [Emma K. Towlson](#), Sang Hoon Lee, and Mason A. Porter. *Journal of Complex Networks*, 2019, doi:10.1093/comnet/cnz013.

***Caenorhabditis elegans* and the network control framework - FAQs**
[Emma K. Towlson](#), Gang Yan, Petra E. Vértés, Yee Lian Chew, Denise S. Walker, William R. Schafer, and Albert-László Barabási. *Phil. Trans. R. Soc. B*, 2018, 373(1758).

NiCE Teacher Workshop: Engaging K-12 Teachers in the Development of Curricular Materials That Utilize Complex Networks Concepts

Emma K. Towlson, Lori Sheetz, Raluca Gera, Jon Roginski, Catherine Cramer, Stephen Uzzo, and Hiroki Sayama. *Complicity*, 2018, 15(1).

Editorial: Bridging Scales and Levels

Emma K. Towlson and Fabrizio De Vico Fallani. *Network Neuroscience*, 2018, 2(3):303-305.

Network control principles predict neuron function in the *C. elegans* connectome

Gang Yan[†], Petra E. Vértés[†], Emma K. Towlson[†], Yee Lian Chew, Denise S. Walker, William R. Schafer, and Albert-László Barabási. *Nature*, 2017, 550: 519-523.

[†] These authors contributed equally to this work.

Recordings of *Caenorhabditis elegans* locomotor behaviour following targeted ablation of single motoneurons

Yee Lian Chew, Denise S. Walker, Emma K. Towlson, Petra E. Vértés, Gang Yan, Albert-László Barabási, and William R. Schafer. *Scientific Data*, 2017, 4: 170156.

The Rich Club of the *C. elegans* Neuronal Connectome

Emma K. Towlson, Petra E. Vértés, Sebastian E. Ahnert, William R. Schafer, and Edward T. Bullmore. *The Journal of Neuroscience*, 2013, 33(15): 6380-6387.

**IN
PREPARATION**

Spatial properties of the mouse brain network

Jose Brum, Albert-László Barabási, and Emma K. Towlson. *In preparation*, 2021.

Diversify Network Science: The State of Race and Gender Diversity in Network Science Scholarship

Emma K. Towlson, Syed Haque, Dina Mistry, Matthew Simonson, Sarah Shugars, and Brooke Foucault-Welles. *Under review*, 2021.

**CONFERENCE
PROCEEDINGS**

Cultivating Tipping Points: Network Science in Teaching

Catherine Cramer, Raluca Gera, Michaela Labriole, Hiroki Sayama, Lori Sheetz, Emma K. Towlson, and Stephen Uzzo. *Complex Networks IX: Proceedings of the 9th Conference on Complex Networks CompleNet 2018*, Springer Proceedings in Complexity, pp 175-183.

Centrality Clubs and Concepts of the Core: Decoding the Communicative Organisation of the Brain

Emma K. Towlson, Petra E. Vértés, Sebastian E. Ahnert, and Edward T. Bullmore. *Proceedings of the European Conference on Complex Systems 2012*, Springer Proceedings in Complexity 2013, pp 497-501.

**INVITED
TALKS**

Control theoretic approaches to understanding brain networks

Controlling Complex Networks satellite, NetSci, Università la Sapienza di Roma (Jul. 2020) *Postponed due to covid-19*

Title TBC

Hotchkiss Brain Institute Research Day (May 2021)

Panelist: Presentation skills, leadership, and diversity for Women in Computer Science

CalgaryHacks online hackathon attended by more than 700 participants (Feb. 2021)

Maximizing subnetwork engagement in the human brain via individualized target search and network control theory

Department of Computer Science, University of Calgary (Feb. 2021)

Understanding brain structure and function through the lens of network science

Department of Physics and Astronomy Colloquium Speaker Series, University of Calgary (Oct. 2020)

Women in Data Science conference, University of Calgary (Mar. 2021)

Panelist: Charting the space between: Pioneers at the Intersections of Neuroscience, Computational Methods, and Machine Intelligence

Neuro Nexus, Alberta-wide competition in which multidisciplinary teams take on challenges in neuroscience and create technological solutions. (Nov. 2020)

Lessons for the classroom from Antarctica: What a new kind of leadership programme taught me about education

Network Science in Education (NetSciEd) (Oct. 2020)

Lessons from Antarctica: Women in STEM changing the narrative of leadership

Diversify NetSci satellite, NetSci, Università la Sapienza di Roma (Sep. 2020)

Network neuroscience lecture at NetSci 2019 school

NetSci, University of Vermont Complex Systems Center (May 2019)

Introduction to Complex Networks & Controllability

Brainhack-Networks, University of Vermont Complex Systems Center (May 2019)

Panelist: Diversify Network Science 2020 and Beyond

Diversify NetSci satellite, NetSci, University of Vermont Complex Systems Center (May 2019)

Network control theoretic approaches to understanding brain structure and function

Biology Department colloquium series, NEU (Apr 2019)

Introduction to network control: Concepts, methods, and applications to neuroscience

Educational lecture at OHBM, Singapore (Jun. 2018)

Control principles in the *Caenorhabditis elegans* nervous system

Talks at Network Neuroscience satellite, NetSci, Paris (Jun. 2018) and Analysis and Interpretation of Connectomes, Janelia Research Campus (May 2018)

Network Science

Talk at the Genetics Bootcamp, Dana-Farber Cancer Institute, Harvard Medical School (Jan. 2018)

How ‘rich’ is your brain?

Contribution to the Minute Madness competition to celebrate the 10th anniversary of women@CL. The Computer Laboratory, University of Cambridge (May 2014).

**TALKS &
CONFERENCE
CONTRIBUTIONS**

Synthetic essentiality: Muscle controllability following multiple neuronal ablations in the *C. elegans* nervous system

Poster at the 22nd International *C. elegans* Conference, University of California, Los Angeles (UCLA). Lightning talk and poster at Network Neuroscience satellite, NetSci, University of Vermont Complex Systems Center (May 2019)

Network Science Tutorial

Boyden Lab retreat, MIT (Sep. 2018)

NiCE Teacher Workshop: Engaging K-12 Teachers in the Development of Curricular Materials That Utilize Complex Networks Concepts

Talk at ICCS, Hyatt Regency Hotel, Cambridge MA (Jul. 2018)

Control principles in the *Caenorhabditis elegans* nervous system

Talks at CompleNet, NEU (Mar. 2018) and Janelia Research Campus (Apr. 2016).

¿Six degrees of separación?: Experiences from designing and implementing an intensive, interdisciplinary, and project-based network science course in Guadalajara

Talk at NetSci, The JW Marriott Hotel, Indianapolis (Jun. 2017).

Experimental Test of Network Control: Functional predictions in the *C. elegans* nervous system

Poster at NetSci, The JW Marriott Hotel, Indianapolis (Jun. 2017)

Spatial Characteristics of Mesoscopic Connections in the Mouse Brain Network

Talk at NetSci, The K-Hotel, Seoul (Jun. 2016).

Connectivity in the Mouse Brain

Talk at Dana-Farber Cancer Institute, Harvard Medical School (Nov. 2015).

A Short Introduction to Networks/Graph Theoretical Analyses

Lecture at the first Summer Workshop on the Dynamic Brain, Friday Harbor Laboratories. Co-hosted by the Allen Institute for Brain Science and the Computational Neuroscience Program at the University of Washington (Sep. 2014).

Brain networks reveal the effects of antipsychotic drugs on schizophrenia patients and controls

Talk at NetSci, University of California Berkeley (Jun. 2014).

The Globally Integrative Rich Club of the *C. elegans* Neuronal Connectome

Talk at 25th IUPAP International Conference on Statistical Physics, Seoul National University (Jul. 2013); poster at NetSci, Copenhagen (Jun. 2013).

Large Scale Brain Networks

Talk at Graduate Research Seminar, Girton College, University of Cambridge (Feb. 2013).

“Networks: Complex Futures”, LERU BRIGHT Conference

Representative for the University of Cambridge, University of Amsterdam (Aug. 2012)

Centrality Clubs and Concepts of the Core: Decoding the Communicative Organisation of the Brain

Talks at the BMU Networks Meeting, University of Cambridge (Oct. 2012) and ECCS, Université Libre de Bruxelles (Sep. 2012); poster at NetSci, Northwestern University (Jun. 2012).

Constructing Dynamic Networks and State Spaces from High Resolution Trading Data: Information Theoretic Approaches

Poster at the 4th Annual Oxford University SIAM Student Conference (Feb. 2011).

EDITORIAL SERVICE

Network Neuroscience, MIT Press
Associate Editor.

Aug. 2019 - present

PLOS Computational Biology
Guest editor.

Jul. 2020

Network Neuroscience, MIT Press

Jun. 2017 - Jun. 2018

Guest editor for Focus Feature “Bridging Scales and Levels” dedicated to participants of the Network Neuroscience satellite at NetSci 2017.

PEER REVIEW

National Science Foundation (NSF) panel: Served on Advisory Panel

Funding proposals: Reviewed for NSF, The City College of New York and Memorial Sloan-Kettering Cancer Center (CCNY-MSK) Partnership, The Templeton Foundation, The Army Research Office (ARO), and The Israel Science Foundation (ISF).

Journals: *Nature*, *Nature Communications*, *Nature Neuroscience*, *PNAS*, *PLOS Computational Biology*, *Network Neuroscience*, *Scientific Reports*, *The European Physical Journal B (EPJ B)*, *IEEE’s Transactions on Network Science and Engineering*, *TopiCS*, *EPJ Data*, *Biosystems*, and *Human Brain Mapping*.

Conference calls: NetSci2020, NERCCS2020, IC2S2 2020, NetSciX 2020, IC2S2 2019, NERCCS 2019, ICCS 2018, NetSci 2018, IC2S2 2018, NetSciX 2018, ComNet 2016 & 2017. Poster judge at Scientista Symposium 2019, NetSci 2018. Oral presentation judge at the 6th Annual PHAS Symposium (University of Calgary).

ORGANISATIONAL LEADERSHIP

The International Conference on Complex Systems 2020

Jul. 2020

Executive Committee Member. Nashua, NH.

The International Conference on Complex Systems 2018

Jul. 2018

Special sessions chair with Dr. Marc Santolini. The Hyatt Regency, Cambridge.

ComNet 2018

Mar. 2018

Local organising chair. NEU, Boston.

Network Neuroscience Satellite

Jun. 2017

The JW Marriott Hotel, Indianapolis.

Spearheaded the timely development of a Brain Networks NetSci associated satellite that had been running for 2 years into a larger Network Neuroscience satellite. Led the committee of ~ 20 experts in the field to achieve this, and sustained over 120 attendees throughout the day, making it one of the largest satellites NetSci has hosted to date. Continuing coordination of expansion for following conferences in 2018-9.

Cavendish Graduate Student Conference 2013

Dec. 2013

Chair of the organising committee for this one day conference for c.150 young physics researchers at Cambridge. Plenary speaker Dr. Simon Singh and sponsored by BP.

Organiser for the Cambridge Networks

Network (CNN)

Jul. 2013 - Mar. 2015

Primarily conglomerated events by liaising with networks groups across the UK.

“The 3 Peaks Challenge: Warwick in Africa... in Wales?!”

Jul. 2011

Organised for and inspired 60 people to climb Ben Nevis, Scafell Pike and Snowdon in 24 hours. The event was covered in local media and raised around £15,000.

Warwick MathPhys Society

May 2008 - Jun. 2011

Co-founded the society, authored 2 revision guides and delivered lectures to undergraduates. By 2011, the society held over 200 members and had secured sponsorship from Teach First.

**COMPUTER
SKILLS**

Languages & Software: Extensive experience with Python programming, Bash scripting, and Matlab. Limited experience with C++.

Working knowledge of network related software (including NetworkX, Cytoscape, Gephi, and GraphViz), L^AT_EX typesetting, Microsoft Office, and OpenOffice. Exposure to image processing software (AFNI and SUMA).

Large-Scale Computing: Experience with cluster computing (Warwick University, Northeastern University), and the Google Cloud Platform.

Operating Systems: Mac OS X, UNIX/Linux, Raspbian, and Windows.

Courses: *C++: Programming in Modern C++*, University Computer Service Training, University of Cambridge (Oct. 2014 - Mar. 2015).

Algorithms: Design and Analysis Part I, online course provided by Stanford University (Oct. 2014 - Dec. 2014).

**HACKATHONS
& STUDENT
COMPETITIONS**

Calgary Hacks 2021

Feb. 2021 Judge of student projects in this 24 hour hackathon attended by more than 700 participants.

Neuro Nexus Challenge Champion

Oct.-Nov. 2020

Led a team of seven students in a six week project to prototype a real-time visualisation of functional brain networks derived from EEG-data. Neuro Nexus is an Alberta-wide competition in which multidisciplinary teams take on challenges in neuroscience and create technological solutions.

Hackathon Team Expert

May 2019

Brainhack-Networks, University of Vermont Complex Systems Center

**EDUCATION
RESEARCH &
DEVELOPMENT**

Network Science Solutions Book

Apr. 2020

Solutions for the problems set in Network Science by Albert-László Barabási.

Networks in Classroom Education (NiCE) Teacher Workshop

Jul. 2017

United States Military Academy (USMA), West Point

Led sessions in this workshop for ~ 30 K-12 teachers of various subjects, aimed at introducing Network thinking to the classroom and as a curriculum development tool.

Network Science Summer Course

Jun. 2017

Universitat Politècnica de Catalunya (UPC), Barcelona

Designed and delivered a week long summer course introducing Network Science to ~ 30 Masters level students in the Statistics department.

Network Science Summer Course

Jun. 2017

Signa Lab, Instituto Tecnológico y de Estudios Superiores de Occidente (ITESO), Guadalajara

Designed a 6 week long summer course introducing Network Science to ~ 20 undergraduate students from diverse disciplinary backgrounds, and delivered 2 of those weeks. The course is highly interactive, including hands-on activities with toy networks, drones, and Lego.

**TEACHING &
SUPERVISION**

Information Introduction to Information

Visualization (CPSC 583)

Jan. 2021 - Apr. 2021

Department of Computer Science, University of Calgary.

Network Neuroscience guest lecture: Neuroscience II Jan. 2021
University of Calgary,

Network Science Graduate Course (PHYS5116) Sep. 2016 - Sep. 2019
Co-instructed with Prof. Albert-László Barabási.
CCNR, Physics Department, Northeastern University.

Summer Internship Jun. 2019 - Sep. 2019
Supervised a bioinformatics student on a project investigating the organisation of functional brain networks in health, depression, and anxiety.

Visiting Faculty Aug. 2016 - Present
Collaborated with and supported Prof. Jose Brum's career change from Director-General of the Brazilian Association for Synchrotron Light Technology to brain research.

Visiting Graduate Students Aug. 2015 - Present
Supervised and co-supervised 3 students visiting CCNR.

The Interdisciplinary Contest in Modeling (ICM) Mar. 2019
Grader for ICM competition, sponsored by the Consortium for Mathematics and its Applications (COMAP).

Summer Student Jun. 2013 - Sep. 2013
Co-supervised a student working on network community structure with Dr. Sebastian Ahnert.

Mathematics IA/B/Biology and Physics Supervisor for Natural Sciences Tripos Students Oct. 2011 - Mar. 2015
324 hours, King's, Trinity, Corpus Christi, and Pembroke Colleges, University of Cambridge.

IB Physics Lab Demonstrator Oct. 2011 - Dec. 2011
Cavendish Laboratory, University of Cambridge.

Mathematics Supervisor Oct. 2010 - Jun. 2011
60 hours, University of Warwick.

OUTREACH

"The Art of Science" window project Feb. 2021
Partnered with student artist Camryn Carnell from Alberta University of the Arts for this project for the Chinook Blast festival. Camryn painted a mural inspired by my research in a business window in Downtown Calgary.

When brains meet circuits: What is a neural networks anyways? Sep. 2020
Delivered a virtual interactive talk to the public on brain networks and neural networks with Kath Blair as part of a Science Takeover event.
Calgary Public Library.

Modern Women in STEM Jun. 2019
Contributed a personal story for a book of stories of women scientists, aiming to inspire girls aged 8-13 years.

"What is so exciting about physics?" Sep. 2015
Featured in a booklet produced by Cavendish Inspiring Women (CiW) and distributed to high schools across the UK.

Physics at Work Sep. 2012
Gave talks on behalf of TCM to teenagers at the Cavendish Laboratory.

Physics Olympiad Jul. 2012, Jul. 2013, Jul. 2014
Coached team of 17-18 year-olds selected to represent the UK in the Physics Olympiad.

VOLUNTEER WORK

Warwick in Africa Project Aug. 2009 - Aug. 2013

- Visited South Africa (Johannesburg and Stellenbosch) 5 times to lead classes and work with the African teachers to improve mathematics education in deprived townships.

- With 11 other volunteers opened a Winter School during the public sector strikes (Aug. 2010) to prepare finalists for their exams which was attended by more than 300 students. Received thanks from the South African Department of Education.
- During a small pilot scheme established links with Stellenbosch University (Jul. 2011) and following a personal ambition arranged for the first set of students from Makapula High School to be entered in the South African Mathematics Olympiad (Mar. 2012).
- Part of the interview panel for 2012 student teacher candidates.
- Co-ordinated the expansion of the scheme in Stellenbosch to involve the National University of Singapore, lecturers from the University of Warwick, and corporate volunteers from Ernst & Young and Standard Chartered (Jul. 2012).