

## Emma K. Towlson

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EMPLOYMENT	<b>Assistant Professor, Network (Neuro)Science</b> Department of Computer Science, University of Calgary	Jun. 2020 - present
	<b>Research Affiliate</b> Massachusetts Institute of Technology P.I.: Prof. Ed Boyden	Apr. 2018 - present
	<b>Associate Research Scientist</b> <b>Part-time Lecturer</b> <b>Postdoctoral Research Associate</b> CCNR, Northeastern University (NEU) P.I.: Prof. Albert-László Barabási	Jan. 2018 - Aug. 2020 Sep. 2016 - Sep. 2019 Apr. 2015 - Jan. 2018
EDUCATION	<b>PhD Physics, Network Science</b> 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
	<b>MMathPhys (First Class Honours)</b> University of Warwick 4th Year project “Superfluidity in Strongly Coupled Light-Matter Systems” Supervisor: Dr. Marzena Szymanska	Oct. 2007 - Jun. 2011
	<b>Undergraduate Research Scholarship Scheme (URSS)</b> University of Warwick Supervisor: Prof. Sandra Chapman	Jul. 2010 - Sep. 2010
FUNDING & AWARDS	<b>NSF NCS-FO: Collaborative Research</b> \$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
	<b>Network Neuroscience Satellite</b> James S. McDonnell Foundation (JSMF) sponsored \$20,000.	Jun. 2017

**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 4<sup>th</sup> 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. *Accepted in Network Neuroscience*, 2019.

**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, Ralucca 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<sup>†</sup>, Petra E. Vértés<sup>†</sup>, Emma K. Towlson<sup>†</sup>, Yee Lian Chew, Denise S. Walker, William R. Schafer, and Albert-László Barabási. *Nature*, 2017, 550: 519-523.

<sup>†</sup> *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.

## **UNDER REVIEW**

### **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*, 2019.

## **IN PREPARATION**

### **Spatial properties of the mouse brain network**

Emma K. Towlson<sup>†</sup>, Jose Brum<sup>†</sup>, and Albert-László Barabási. *In preparation*, 2019.

<sup>†</sup> *These authors contributed equally to this work.*

## **CONFERENCE PROCEEDINGS**

### **Cultivating Tipping Points: Network Science in Teaching**

Catherine Cramer, Ralucca Gera, Michaela Labriole, Hiroki Sayama, Lori Sheetz, Emma K. Towlson, and Stephen Uzzo. *Complex Networks IX: Proceedings of the 9<sup>th</sup> 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*

### **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 22<sup>nd</sup> 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)

**Hackathon Team Expert**

Brainhack-Networks, 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.***

***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.

## 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.  
**CompleNet 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<sup>A</sup>T<sub>E</sub>X 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).

## 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  $\sim 30$  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  $\sim 30$  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  $\sim 20$  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

**Network Science Graduate Course** 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

**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).