

Emma K. Towlson

Center for Complex Network Research (CCNR), Northeastern University
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- EMPLOYMENT** **Associate Research Scientist** Jan. 2018 - present
Part-time Lecturer Sep. 2016 - present
Postdoctoral Research Associate Apr. 2015 - Jan. 2018
CCNR, Northeastern University
P.I.: Prof. Albert-László Barabási
- EDUCATION** **PhD Physics, Network Science** Oct. 2011 - Mar. 2015
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
MMathPhys (First Class Honours) Oct. 2007 - Jun. 2011
University of Warwick
4th Year project “Superfluidity in Strongly Coupled Light-Matter Systems”
Supervisor: Dr. Marzena Szymanska
Undergraduate Research Scholarship Scheme (URSS) Jul. 2010 - Sep. 2010
University of Warwick
Supervisor: Prof. Sandra Chapman
- 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).
- EDITORIAL DUTIES** **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** **Journals:** *Nature Neuroscience*, *PLOS Computational Biology*, *Network Neuroscience*, *Scientific Reports*, and *The European Physical Journal B (EPJ B)*.
Funding proposals: National Science Foundation (NSF), The City College of New

York and Memorial Sloan-Kettering Cancer Center (CCNY-MSK) Partnership, and the Army Research Office (ARO).

Conference calls: CompleNet 2016 & 2017, NetSciX 2018.

PUBLICATIONS **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 motorneurons

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.

Understanding Rich Club with a Stochastic Block Model: A Connectome Study of Resting-State Schizophrenia

Soroosh Afyouni, Dragana M. Pavlovic, Emma K. Towlson, Petra E. Vértés, Theodoros N. Arvanitis, Edward T. Bullmore, and Thomas E. Nichols. *In preparation*, 2017.

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. *In preparation*, 2017.

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. *In preparation*, 2017.

Multi-Subject Stochastic Blockmodels for Adaptive Analysis of Individual Differences in Human Brain Network Cluster Structure

Dragana M. Pavlović, Bryan Guillaume, Emma Towlson, Soroosh Afyouni, Petra E. Vértés, Thomas Yeo, Edward T. Bullmore, and Thomas E. Nichols.

Under review at NeuroImage, 2017.

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.

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

PROCEEDINGS

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

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.

**TALKS &
CONFERENCE
CONTRIBUTIONS**

¿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).

Control principles in the *Caenorhabditis elegans* nervous system

Talk at Janelia Research Campus (Apr. 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 (Jun. 2014).

How ‘rich’ is your brain?

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

**FUNDING &
AWARDS**

NSF NCS-FO: Collaborative Research

Oct. 2017

\$237,499 over 2 years (of the \$707,296 total awarded to four groups).

Title: Ground-Truth Analysis and Modeling of Entire Individual *C. elegans* Nervous

Systems

P.I.s: Prof. Edward Boyden (MIT), Prof. Albert-László Barabási (NEU), Prof. Max Tegmark (MIT), and Prof. Steven Flavel (MIT).

Responsible for the Barabásilab component of the grant, both in terms of writing the proposal and carrying out the research given its success.

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.

**ORGANISA-
TIONAL
EXPERIENCE**

The International Conference on Complex Systems 2018 Jul. 2018

Special sessions chair. 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 the next conference in Jun. 2018.

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.

**EDUCATION
RESEARCH &
DEVELOPMENT**

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

- Network Science Graduate Course** Sep. 2016 - Present
Co-instructed with Prof. Albert-László Barabási and Dr. Sean Cornelius.
CCNR, Physics Department, Northeastern University.
- Visiting Faculty** Aug. 2016 - Present
Collaborated with and supported 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 2 students visiting CCNR.
- 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.
- 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

- "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/Senior Physics Challenge** Jul. 2012, Jul. 2013, Jul. 2014
Coach for the team of 17-18 year olds selected to represent the UK in the Physics Olympiad.

VOLUNTARY 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).