Curriculum Vitae

Mengsen Zhang

The Human Brain and Behavior Laboratory
Center for Complex Systems and Brain Sciences (BS-12)
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Education

2013- **Ph.D. Candidate**, in Complex Systems and Brain Sciences, Florida Atlantic University
2013 Complex System Summer School, Santa Fe Institute
2011-2012 **M.S.** in Criminology, University of Pennsylvania
2007-2011 **B.S.** in Psychology, Peking University
B.S. in Pharmacology, Peking University

Research Experience

2013- **Graduate Research**, the Human Brain and Behavior Laboratory, Center for Complex Systems and Brain Sciences, Florida Atlantic University
Mentors: Drs. Emmanuelle Tognoli and J.A. Scott Kelso.
Dissertation: Social Coordination Dynamics - a theoretical and experimental investigation of human social coordination in terms of behavioral, physiological and neural dynamics.
Projects:
Experimental: (1) designed a new paradigm to study multiagent coordination dynamics in ensembles of eight people, with parametrically manipulable frequencies and network connectivity; studied phase and frequency coordination under different frequency diversity. (2) studied human emotional responses during social coordination with a Virtual Partner (using Human Dynamic Clamp paradigm: human coordinating in real time with a model of human social coordination). (3) currently study neural dynamics (EEG and fMRI) during human social coordination with a Virtual Partner whose coupling strength towards human was parametrically manipulated.
Modelling: (1) reproduced metastable coordination patterns and pattern switching in experimental data of multiagent coordination, generalizable to arbitrary numbers of components. (2) reproduced the critical level of diversity that demarcates the regimes of social integration and segregation observed in human experiment.
Applied Mathematics: (1) study methods of computational topology in identifying collective pattern switching in experimental data of multiagent coordination. (2) study pattern formation of reaction-diffusion systems on growing and irregular domains with finite element method. (3) study rigorous computation of stable/unstable manifolds of nonlinear ODEs.
Engineering: (1) developed apparatus for real time study of multiagent coordination dynamics: hardware engineering of touch sensors, integrated circuits; and software engineering of a microcontroller-PC signal processing pipeline. (2) developed GPU programs (written in CUDA C++, interfacing with MATLAB) to simulate multiagent social coordination in parallel, achieved ~1000 times faster computation (generating ~1 Terabyte simulated data per hour) than MATLAB built-in ODE solvers; developed GPU programs for Continuous Wavelet Transform, outperform MATLAB built-in function ~100 times.

2013-2014 **Research Project**, Complex System Summer School, Santa Fe Institute
Collaborators: Bruno Pace and Dr. Tom Carter
Project: Simulation of Evolutionary Dynamics and Fitness Landscapes.

2013 **Research Project**, Complex System Summer School, Santa Fe Institute
Collaborators: D. Massad, E. Omodei, C. Strohecker, Dr. Y. Xu, J. Garland and Dr. L. F. Seoane
Project: Unfolding History: Classification and analysis of written history as a complex system, using Wikipedia editing data of networks of historical events.

2012-2013 **Research Coordinator**, Center for functional Neuroimaging (CfN), University of Pennsylvania
Supervisor: Dr. Hengyi Rao, Dr. John Detre
Projects: *f*MRI correlates of individual differences in risk taking in healthy controls and patients with

cocaine addiction; *f*MRI correlates of risk taking in smokers before and after smoking abstinence.

2012 **Masters Research**, Department of Criminology, University of Pennsylvania
Supervisor: Dr. John Roman
Project: The role of internet in shaping traditional crime with data from Federal Uniform Crime Report.

2011-2012 **Research Assistant**, Jerry Lee Center of Criminology, University of Pennsylvania
Supervisor: Dr. Adrian Raine
Project: Health, Brains and Behavior Study: the etiology and treatment of conduct disorder, aggression, and psychopathy in 11-12 year old children from the community in Philadelphia.

2010-2011 **Bachelor Thesis**, Dept. of Clinical Pharmacology, Peking University
Supervisor: Yiheng Yang, Associate Chief Pharmacist
Project: A meta-analysis of 59 clinical studies on Ginkgo Biloba leaves injection's effect on Coronary Heart Disease in Chinese population.

2010-2011 **Research Assistant**, Behavior and Neuroeconomics Lab, Peking University
Supervisor: Dr. Xiaolin Zhou
Project: The impact of social comparison on economic decision-making in different fairness contexts.

2010-2011 **Research Assistant**, Neuroscience Research Institute, Peking University
Supervisor: Dr. Cai-Lian Cui
Project: Study on the neurobiological basis of opioid addiction in animal models.

2008-2011 **Research Assistant**, Department of Psychology, Peking University
Supervisor: Dr. Liqing Zhang
Projects: Self-Esteem and Social Decision-Making; A Meta-Analysis Study of Self-Esteem and Its Psychological Correlates in Chinese Population.

Publications

Mengsen Zhang, J. A. Scott Kelso, Emmanuelle Tognoli (*2018*). **Critical diversity: Divided or united states of social coordination.** PLOS ONE 13(4): e0193843. https://doi.org/10.1371/journal.pone.0193843

Emmanuelle Tognoli, Mengsen Zhang, and J. A. Scott Kelso (*2018*). **On the Nature of Coordination in Nature**. *Advances in Cognitive Neurodynamics VI* (Ed. JM Delgado-Garcia).

Guillaume Dumas, Aline Lefebvre, Mengsen Zhang, Emmanuelle Tognoli, and J.A. Scott Kelso (2018). **The Human Dynamic Clamp: a probe for Coordination across Neural, Behavioral, and Social Scales**. In: Müller S., Plath P., Radons G., Fuchs A. (eds). *Complexity and Synergetics* (Springer, Cham). https://doi.org/10.1007/978-3-319-64334-2_24

Mengsen Zhang, Guillaume Dumas, J. A. Scott Kelso, and Emmanuelle Tognoli. (2016). **Enhanced emotional responses during social coordination with a virtual partner**. *International Journal of Psychophysiology*, 104, 33-43. http://dx.doi.org/10.1016/j.ijpsycho.2016.04.001 **[Altmetric, 95th percentile, an index of public interest]**

Mengsen Zhang, Craig Nordham, and J. A. Scott Kelso (2015). **Deterministic versus probabilistic causality in the brain: to cut or not to cut**. *Physics of Life Review*, 15: 136-138. http://dx.doi.org/10.1016/j.plrev.2015.10.002

Invited Talks

Mengsen Zhang (2017). **Identifying pattern changes in human rhythmic movement coordination with persistent homology.** (*Invited talk, Analysis and Applications Seminar, Department of Mathematics, Florida Atlantic University*)

Mengsen Zhang (2016). **Multiagent social coordination dynamics.** *(Invited talk, Department of Psychology, University of Miami, FL)*

Abstracts/Presentations

Mengsen Zhang, Christopher Beetle, J. A. Scott Kelso, Emmanuelle Tognoli (2018). **Linking the many and the few: an experimental-theoretical analysis of multiagent coordination**. *(Oral presentation, the Ninth International Conference on Complex Systems, July 2018, Cambridge, MA, USA)*

J. A. Scott Kelso, Mengsen Zhang, and Emmanuelle Tognoli (2018). **Coordination laws for couples and collectives: What about the 'in-between'?** (*Society of Experimental Psychologists, Tucson, Arizona, March 1-4, 2018.*)

Mengsen Zhang, J.A. Scott Kelso, and Emmanuelle Tognoli (2017). **Multiagent Social Coordination Dynamics – from Experiment to Model.** *(Society for Neuroscience Annual Meeting, Washington, DC, 2017)*

Mengsen Zhang, J.A. Scott Kelso, and Emmanuelle Tognoli (2017). **Multiagent Coordination Dynamics: the Human Firefly Experiment.** *(Oral presentation, Conference on Complex Systems, Cancun, Mexico, 2017)*

Mengsen Zhang, J.A. Scott Kelso, and Emmanuelle Tognoli (2017). **A New Paradigm for Studying Pattern Generation in Multiagent Systems.** *(Poster, Progress in Motor Control XI, Miami, Florida, July, 2017)*

Emmanuelle Tognoli, Mengsen Zhang, and J.A. Scott Kelso (2017). **On the nature of Coordination in Nature.** *(Oral presentation, 6th International Conference on Cognitive Neurodynamics, Carmona, Spain, August 1-5, 2017)*

Mengsen Zhang, J.A. Scott Kelso, and Emmanuelle Tognoli (2016). **How social coordination emerges and changes among multiple heterogeneous agents: An experimental 'human firefly' study.** *(Poster, Society for Neuroscience Annual Meeting, San Diego, CA, November, 2016)*

Mengsen Zhang, Guillaume Dumas, Emmanuelle Tognoli, J.A. Scott Kelso (2014). **Emotional Response during Human-Virtual Partner Interaction**. *(Poster, Society for Neuroscience 2014, Washington DC)*

Mengsen Zhang (2013). **Simplicity (Synthesizing questions - in search of a simple analogy of complexity)**. (Oral presentation, Complex System Summer School, Santa Fe Institute, June 28, 2013)

Bruno Pace, Mengsen Zhang and Tom Carter (2013). **Evolutionary Dynamics**. (Oral presentation, Complex System Summer School, Santa Fe Institute, June 28, 2013)

Mengsen Zhang (2012). **Agent-Based Modeling and Its Potential Use in Developing Criminology Theories with Interdisciplinary Evidence**. *(Oral presentation, the 64th Annual Meeting of the American Society of Criminology, Chicago, November 15, 2012.)*

Mengsen Zhang and Adrian Raine (2011). **Psychopathic Personality Enhances Proactive Aggression in East Asian Females But Not Males.** *(Poster, the 63rd Annual Meeting of the American Society of Criminology, Washington, D.C., November 17, 2011)*

Adrian Raine, Mengsen Zhang, Sarah Appelby, and Peter H. Venables (2011). **Early Childhood Risk Factors for Psychopathic Personality in Adulthood: Findings from the Mauritius Child Health Project.** *(Oral presentation, 4th biennial meeting of the Society for the Scientific Study of Psychopathy, Montreal, Canada, May 20, 2011)*

Awards

2016 **FAU Brain Institute Travel Award**
2016 **NSF Travel award**, Society for Social Neuroscience. (ID: 1543122; PI: Dr. Stephanie Cacioppo)
2014 **Graduate Fellowship of Academic Excellence**, Florida Atlantic University.
2014 **1-st Year Graduate Research Award**, College of Science Research Day, Florida Atlantic University.

Public Outreach, Press Coverage

Science Daily – May 17th, 2016
'Virtual partner' elicits emotional responses from a human partner in real-time.
https://www.sciencedaily.com/releases/2016/05/160517094204.htm

The Stack – May 20th, 2016
Virtual partner created for 'emotional' Turing test
https://thestack.com/world/2016/05/20/virtual-partner-created-for-emotional-turing-test/

University Press – May 23rd, 2016
"Virtual partner" is a technology that can play with your emotions
http://www.upressonline.com/2016/05/virtual-partner-is-a-technology-that-can-play-with-your-emotions/

Guokr (a Chinese popular science-technology network) – May 26th, 2016
Human-human coordination vs. human-machine coordination: same for emotion? (in Chinese)
http://www.guokr.com/article/441468/

Professional Membership

2017- Society for Industrial and Applied Mathematics
2014- Society for Neuroscience
2011-2013 American Society of Criminology

Professional Service

2017- **Secretary**, Society for Industrial and Applied Mathematics, Florida Atlantic University Student Chapter

Peer reviewer for journal articles: Cognitive Processing, Cognitive Systems Research, Biological Cybernetics*, International Journal of Psychophysiology*, PLoS*, Physics of Life Reviews*, Psychological Science*, Journal of Neuroscience Research*. (* assisting Dr. J. A. Scott Kelso)

Mentoring

2015- Advisor of undergraduate research assistant Ananda Chowdhury (Engineering, FAU) on analyzing dynamic system data with MATLAB.
2015-2016 Advisor of undergraduate research assistant Daniela Herrera (Neuroscience, FAU) on experiments of multiagent social coordination.

Other Experience

2013- **Teaching Assistant**, Center for Complex Systems and Brain Sciences, Florida Atlantic University
2010-2011 **Internship**, Phase III Clinical Trial Laboratory, Pharmacy Department, Peking University Third Hospital
2009-2010 **Teaching Assistant**, Social Psychology, Instructor: Liqing Zhang, Assistant Professor
2008-2009 **Director of University Radio Station**, Peking University Health Science Center
2007-2008 **Minister of the Student Association of Psychology**, Peking University Health Science Center

Computing Skills

- System: Windows, Mac OS, Linux
- Application: Microsoft Office, Adobe Photoshop/Illustrator.
- Statistics: Matlab, R, SAS, SPSS, Review Manager, SPM
- Data/Lab: AFNI, Neuroscan, Acqknowledge, Matlab/PsychToolBox, FreeSurfer
- Programming: Matlab, C/C++, CUDA C/C++, Mathematica, Python, NetLogo, Javascript, Lisp
- Others: Arduino (microcontrollers), Eagle (circuit design), INTLAB (interval arithmetic)