Curriculum vitae

Mohsen Bahrami

Contact Information

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Education

PhD, Biomedical Engineering, 2015 – present (GPA: 3.97/4) – Research Assistant

Virginia Tech – Wake Forest University School of Biomedical Engineering and Science, Winston – Salem, NC, USA

Advisors: Paul J. Laurienti, MD, PhD. Professor & Sean L. Simpson, PhD. Associate Professor

MS, Biomedical Engineering, 2011 – 2014 (GPA: 3.85/4)

University of Tehran, Tehran, Iran

Thesis Title: *"Analysis and Comparison of fMRI Resting-States Functional Connectivity in Patients with Alzheimer's Disease and Healthy Controls"* *(Score: 20/20 - Excellent)*
Advisor: Gholam-Ali Hossein-Zadeh, PhD. Professor

BS, Electrical Engineering (Electronics), 2006 – 2010

Razi University, Kermanshah, Iran

Research Interests

- ✓ Neuroimaging data analyses and medical imaging
- ✓ Complex brain networks and brain connectivity
- ✓ Multivariate models in brain network studies
- ✓ Clinical applications of neuroimaging data
- ✓ Deep learning and machine learning methods

- ✓ Statistical signal processing and image processing
- ✓ Computational and theoretical neuroscience

Bibliography

Peer-Reviewed Journal Articles

1. **Bahrami M**, Laurienti PJ, Simpson SL **(2019).** "Analysis of Brain Subnetworks within the Context of their Whole-Brain Networks." *Hum Brain Mapp*. Accepted.

2. **Bahrami M**, Laurienti PJ, Simpson SL **(2019).** "A MATLAB Toolbox for Multivariate Analyses of Brain Networks." *Hum Brain Mapp*. 40(1):175-186. doi: 10.1002/hbm.24363.

3. Simpson SL, **Bahrami M**, Laurienti PJ **(2019)**. "A Mixed Modeling Framework for Analyzing Multitask Whole Brain Network Data." *Network Neuroscience*. 3(2):307-324. doi: 10.1162/netn_a_00065.

4. **Bahrami M**, Laurienti PJ, Quandt SA, Talton J, Pope CN, Summers P, Burdette JH, Chen HY, Liu J, Howard TD, Arcury TA, Simpson SL **(2017)**."The Impacts of Pesticide and Nicotine Exposures on Functional Brain Networks in Latino Immigrant Workers." *Neurotoxicology*.62:138-150.

Manuscripts in Preparation

1. **Bahrami M**, Lyday RG, Casanova R, Burdette JH, Simpson SL, Laurienti PJ **(2019)**. "Using Dynamic Trajectories to Visualize, Analyze, and Interpret Dynamic Functional Brain Networks." *Frontiers in Human Neuroscience*, Submitted.

2. Peterson H, Mayhugh R, Rejeski JW, **Bahrami M**, Simpson SL, Heilman K, Porges SW, Laurienti PJ **(2019)**. "Relationship between Cardiac Vagal Tone and Functional Brain Connectivity in Moderate to Heavy Alcohol Consumers." In Preparation.

Peer-Reviewed Extended Abstracts (Published)

1. **Bahrami M**, Hossein-Zadeh GA **(2015)**. "Assortativity Changes in Alzheimer's Disease: A Resting-State fMRI Study." *IEEE 23rd Iranian Conference on Electrical Engineering (ICEE)*. Tehran, Iran. Publisher: IEEE. Pages:141-144. doi: 10.1109/IranianCEE.2015.7146198.

2. **Bahrami M**, Hossein-Zadeh GA **(2014)**. "Functional Parcellation Affect Network Measures in Graph Analysis of Resting-State fMRI." *21rd Iranian Conference on Biomedical Engineering (ICBME).* Tehran, Iran. Publisher: IEEE. Pages:263-268. doi: 10.1109/ICBME.2014.7043933.

3. Yousefi H, **Bahrami M**, Fatehi M, Zoroofi RA **(2014)**. "3D Statistical Shape Models of Radius Bone for Segmentation in Multi Resolution MRI Data Sets." *21ʳᵈ Iranian Conference on Biomedical Engineering (ICBME)*. Tehran, Iran. Publisher: IEEE. Pages:246-251. doi: 10.1109/ICBME.2014.7043930.

Abstracts/Scientific Exhibits/Presentations at National and International Meetings

1. (*Invited Presentation*) **Bahrami M**, Simpson SL, Arcury TA, Laurienti PJ. "A Mixed-Effects Modeling Approach to Study the Impacts of Pesticides on Farmworkers' Brain Networks Using RS-FMRI Data." *Joint Statistical Meetings.* Chicago, IL. Summer 2016.

2. **Bahrami M**, Laurienti PJ, Simpson SL. "Analyzing Local Subnetworks: Context is Everything." *NetSci*. Burlington, VT. Summer 2019.

3. Peterson H, Mayhugh R, Rejeski JW, **Bahrami M**, Simpson SL, Heilman K, Porges SW, Laurienti PJ. "Relationship between Cardiac Vagal Tone and Functional Brain Connectivity in Moderate to Heavy Alcohol Consumers." *Netsci*. Burlington, VT. Summer 2019.

4. **Bahrami M**, Laurienti PJ, Simpson SL. "A Matlab Toolbox for Multivariate Analysis of Brain Networks." *BMES Annual Meeting*. Atlanta GA. Fall 2018.

5. **Bahrami M**, Laurienti PJ, Simpson SL. "A Matlab Toolbox for Multivariate Analysis of Brain Networks." *Statistical Methods in Imaging*. Philadelphia PA. Summer 2018.

6. **Bahrami M**, Laurienti PJ, Arcury TA, Simpson SL. "Brain Networks in Latino Farmworkers with Chronic Exposures to Pesticides." *BMES Annual Meeting*. Phoenix AZ. Fall 2017.

7. **Bahrami M**, Laurienti PJ, Arcury TA, Simpson SL. "The Impacts of Pesticide and Nicotine on Functional Brain Networks in Latino Farmworkers." *North Carolina cognition Group Conference*. Greensboro NC. Spring 2017.

8. **Bahrami M**, Laurienti PJ, Sandberg JC, Daniel SS, Arcury TA, Simpson SL. "The Impact of Pesticide on Latino Farmworkers' Functional Brain Networks." *NIEHS Environmental Health Science FEST*. Research Triangle Park NC, Fall 2016.

9. **Bahrami M**, Borjkhani M, Hossein-Zadeh GA, Bahrami F. "Lyapunove Exponent as a Feature to Distinguish Patients with Alzheimer's Disease and Healthy Controls Using Resting-State fMRI BOLD Signals." *1ˢᵗ Iranian Conference on Human Brain Mapping*. Tehran, Iran. Fall 2014.

10. **Bahrami M**, Hossein-Zadeh GA. "A Comparison Between Statistical characteristics of a Copula-Based Measure and Cross-Correlation in Resting-State fMRI Connectivity Analysis." *1ˢᵗ Iranian Conference on Human Brain Mapping*. Tehran, Iran, Fall 2014.

11. **Bahrami M**, Hossein-Zadeh GA. "On the Robustness of Copula-Based Measures of Connectivity Analysis for Resting-State fMRI Data Analysis." *5th Iranian Conference on Bioinformatics (ICB 2014)*. Tehran, Iran. Spring 2014.

Non-Conference Presentations

1. **Bahrami M**, Lyday RG, Casanova R, Burdette JH, Simpson SL, Laurienti PJ. "Trajectories of Dynamic Functional Brain Networks." *SBES Symposium*. Virginia Tech, Blacksburg, VA. Spring 2019.

2. **Bahrami M**, Laurienti PJ, Simpson SL. "A Multivariate Model for Statistical Assessments of Biological Networks." *Center for Molecular Signaling (CMS) Seminar*. Wake Forest School of Medicine, Winston – Salem, NC. Spring 2018.

3. **Bahrami M**, Laurienti PJ, Simpson SL. "A Matlab Toolbox for Multivariate Analysis of Brain Networks." *Carolina Network Research Group (NRG) Meeting*. UNC, Chapel Hill, NC. Spring 2018.

4. **Bahrami M**, Laurienti PJ, Simpson PL. "A Matlab Toolbox for Multivariate Analysis of Brain Networks." *SBES Annual Symposium*. Wake Forest School of Medicine, Winston – Salem, NC. Spring 2018.

5. **Bahrami M**, Laurienti PJ, Arcury TA, Simpson PL. "The Impacts of Pesticide and Nicotine on Functional Brain Networks in Latino Farmworkers." *SBES Annual Symposium*. Virginia Tech, Blacksburg, VA. Spring 2017.

6. **Bahrami M**, Laurienti PJ, Arcury TA, Simpson PL. "The Impacts of Pesticide and Nicotine on Functional Brain Networks in Latino Farmworkers." *Research Day.* Wake Forest School of Medicine, Winston - Salem, NC. Spring 2017.

7. **Bahrami M**, Laurienti PJ, Arcury TA, Simpson PL. "A Mixed-Effects Modeling Approach to study the Impacts of Pesticide on Farmworkers' Brain Networks Using R-fMRI Data." SBES Annual Symposium. Wake Forest School of Medicine, Winston - Salem, NC. Spring 2016.

Review of Journal Articles

- NeuroImage, 15-3306
- Brain Connectivity, 0426
- Human Brain Mapping, 17-0462
- Statistical Analysis and Data Mining, SAM-18-007
- Brain Connectivity, BRAIN-2018-0598
- NeuroImage, 17-621
- TNSRE, 00268
- Frontiers in Physics, 460766

Awards and Honors

- ✓ Admitted into the MS program of the most prestigious university of Iran, University of Tehran, 2011.
- ✓ Ranked among top 0.5% of more than 434000 participants of BS national entrance exam in mathematics and physics major, 2006.
- ✓ 1st rank, achieving the highest GPA among Biomedcial Engineering graduate (MS) students.
- ✓ Multiple local awards, including a clinical neuroscience project award for the best grant proposal, Fall 2016.

Professional Membership and Services

- Biomedical Engineering Society (BMES) Organization, Fall 2016 – Present
- American Statistical Association, Spring 2016 – Present
- Workshops on Scientific Integrity and Professional Development at Many National Conferences, as well as Wake Forest Graduate School of Arts and Sciences, Fall 2015 – Present

Research Funding

2015 – 2017: Researcher on the following grants:

- **NIEHS ROI1 ES008739-16S1 –** CBPR on Pesticide Exposure & Neurological Outcomes for Latinos (PI: Tom Arcury, PhD, Project PI: Paul Laurienti, MD, PhD)**:** This supplementary project is aimed at obtaining magnetic resonance brain imaging for the parent study examining the effects of agricultural pesticides in migrant and seasonal Latino farmworkers.

- **K25 EB012236 –** Statistical Methods for Whole-Brain Connectivity Networks (PI: Sean Simpson, PhD): The goal of this project is to establish multidisciplinary neuroimaging methods to address disease of the brain.

- **P50 AA026117 -** How Mindfulness Modulates Craving And Brain Networks in Moderate-To-Heavy Drinkers (PI: Jeffrey Weiner, PhD, Project PI: Paul Laurienti, MD, PhD): The goal of this project is to study how mindfulness modulates craving and brain networks in moderate-to-heavy drinkers. This project has the potential to guide the development of future

clinical trials to better target clinical outcomes by understanding corresponding mechanisms supporting meditations-related reductions in alcohol craving.

2017 - 2018: Researcher on the following grant:

- **NIEHS RO1 ES008739 –** The Effects of Pesticide Exposure on Cognitive and Brain Development in Latino Children (Co-PIs: Paul Laurienti, MD, PhD & Tom Arcury, PhD): This project is an extension of the work that has been performed over the past 20 years (RO1 ES008739-19) and will evaluate the effects of pesticide exposure on neurobehavioral and brain development in children in Latino farmworker families.

2018 – Present: Researcher on the following grant:

- **NIH RO1 EB024559 -** Analytical tools for Complex Brain Networks: Fusing Novel Statistical Methods and Network Science to Understand Brain Function (PI: Sean Simpson, PhD): Thie project will fuse novel statistical methods with network-based functional neuroimaging analysis to engender powerful analytical tools to advance understanding of normal brain function and alterations due to various brain disorders.

Projects

Software (More than 270 downloads so far since release in 2019)

- *WFU_MMNET: Multivariate Modeling of Brain Networks Toolbox*

We developed this promsing multi programming language software, developed and implemented appropriate data reduction methods for modeling larger datasets, and published the paper describing the toolbox in a top medical imaging journal (Human Brain Mapping).

This toolbox with user-friendly GUIs makes a very promising multivariate modeling framework accessible to a wide range of investigators and clinicians interested in studying the brain and its abnormalities. It allows assessing brain network differences between study populations as well as assessing the effects of phenotypic variables such as aging, task performance, and disease states on brain connectivity and brain network. A variety of neuroimaging data such as fMRI, EEG, MEG, and DTI can be analyzed with this toolbox. The toolbox has been developed in MATLAB, but uses SAS, R, or Python (depending on software availability) to perform the statistical modeling.

To the best of our knowledge, this is the first toolbox which allows analyzing and comparing brain networks while controlling for any potential source of indigenous or exogenous source of confounding effect. The uploaded toolbox along with its user manual and provided case study has been downloaded more than 270 times so far since being released on the NITRC repository: https://www.nitrc.org/projects/wfu_mmnet/
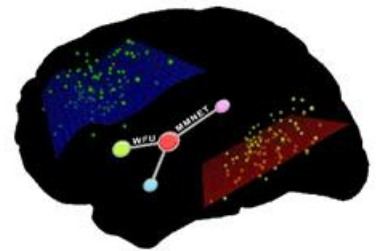
Studies

✚ *Mixed Models for Local Brain Subnetworks*

To the best of our knowledge, this study provides a first baseline modeling framework to study local brain subnetworks within the context of their whole-brain networks while controlling for many potential sources of confounding effect. I have recently published this work in one of the top medical imaging journals (Human Brain Mapping) as the first author. This paper presents the theoretical development of the model, and the promise of it with simulation and empirical study on moderate-to-heavy alcohol consumption data. This model was developed by extending a previously developed mixed-effects modeling framework for whole-brain network studies.
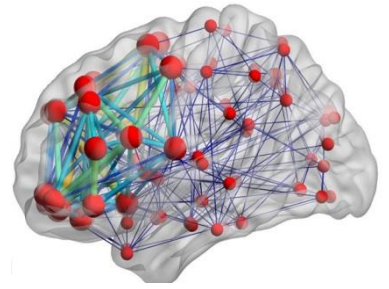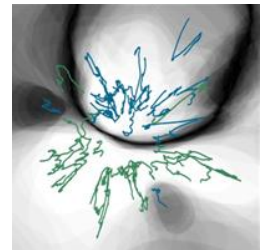
Despite the fact that the brain, as a complex system of interacting subsystems (i.e., subnetworks), cannot be fully understood by analyzing its constituent parts as independent networks, most current methods extract subnetworks from the whole and treat them as independent networks. This approach entails neglecting their interactions with other brain regions and precludes identifying unknown, unanticipated, and compensatory mechanisms outside the analyzed subnetwork. As most neurological and psychiatric disorders such as Alzheimer's disease, Schizophrenia, ADHD, depression, and autism usually affect multiple systems of the brain with a complex pattern, conventional methods could potentially produce misleading and inconsistent outcomes. Our developed framework could have a substantial impact on better identifying abnormalities produced by such disorders as it will allow including interactions of brain subnetworks at multiple resolutions with many other strengths detailed in the published paper.

Currently, I am working on developing GUIs and adding them to WFU_MMNET (Matlab Toolbox described above) to allow wider use of this model.

✚ *Low-Dimensional Dynamic Trajectories of Brain Network Changes*

Changes of brain network over very short periods of time have been associated with cognitive functional and neurological disorders. However, the big complex data used for analyses of brain network changes makes meaningful visualization and interpretation of such changes an exceptional challenge. In this work, we represent such changes as dynamic trajectories in 2D or 3D space.
We show that these dynamic trajectories contain meaningful information, as they are able to successfully discriminate between cognitive tasks and study populations. *Our work provides evidence that such dynamic trajectories have the potential to help us better understand basic neural processes as well as brain diseases, disorders, and treatments.*

✚ *Brain Connectivity and IQ in HCP participants*

This study investigates the association of brain network and brain connectivity with Human intelligence quotient (IQ) using the entire data of Human Connoctome Prject (HCP) as the most high-quality data available. This study will open new avenues into understanding the brain and intelligence. This work is funded by the NIH RO1 EB024559.

Also, the association between structural and functional organizations of the brain will be investigated in this study. Understanding the underlying structure (anatomy) of the brain function is one of the biggest challenges in neuroscience, and the strong modeling framework along with the usage of high-quality HCP data can provide a new perspective into understanding the structural-functional brain associations.

The HCP is a big project sponsored by sixteen components of the National Institute of Health (NIH), split between two consortia of research institutions, including: Washington University in Saint Loius and the University of Minnesota, with strong contributions from Oxford University, Harvard University, Massachusetts General Hospital and the University of California Los Angeles.

✚ *The Effect of Pesticide Exposures on Cognitive and Brain Development in Latino Children*

This work investigates abnormalities of brain networks in children of immigrant workers with chronic exposures to pesticide and nicotine. In our previous study we have shown that chronic exposures to pesticide and nicotine alter the brain network of such immigrants such that it could produce complications for high-level cognitive tasks in their later life. Here we hypothesize that such exposures affect the brain of their children as well.

✚ *How Mindfulness Modulates Craving And Brain Networks in Moderate-To-Heavy Drinkers*

Using the developed software and methodological extensions for regional subnetwork analyses, a part of this study looks into the brain network connections differences between a period of normal drinking and period of alcohol abstinence in moderate to heavy alcohol consumers.

Professional Skills

Programming

Skill	Rating
MATLAB	●●●●●●
R	●●●●○○
Python	●●○○○○
SAS	●●○○○○
C	●●●○○○
SLURM	●●●●○○
Unix and Shell	●●●●○○

Neuroimaging Software

FSL	● ● ● ● ● ●
SPM	● ● ● ● ● ○
FreeSurfer	● ● ● ○ ○ ○
CAMINO	● ● ● ○ ○ ○
MRICRON	● ● ● ● ● ○
REST/DPARSF	● ● ● ● ● ●
BCT	● ● ● ● ● ●

Teaching Assistant

- *Functional Medical Imaging Systems, Graduate Course, Spring 2014*
- *Pattern Recognition, Graduate Course, Fall 2014*
- *Pattern Recognition, Graduate Course, Fall 2013*

Other Interests

- *Music*

   Professional musician playing TAR (a Persian long-necked, waisted instrument) in public events as well as occasional singing.

- *Poetry and Novels*

   Reading poems and novels on a regular basis and participating at local poetry nights.

- *Sports*

   Playing volleyball and soccer and occasionally hiking

References

- **Paul J. Laurienti, M.D, Ph.D. Professor.** Department of Radiology, Wake Forest School of Medicine, Medical Center Boulevard, Winston-Salem, NC 27157-1088. Telephone: (336) 716-3261. E-mail: plaurien@wakehealth.edu

- **Sean L. Simpson, Ph.D. Associate Professor.** Department of Biostatistical Sciences, Wake Forest School of Medicine, Medical Center Boulevard, Winston-Salem, NC 27157-1063. Telephone: (336) 716-8369. E-mail: slsimpso@wakehealth.edu

- **Gholam-Ali Hossein-Zadeh, Ph.D. Professor.** Department of Electrical Engineering, College of Engineering, University of Tehran, Amir Abad, Tehran, Iran. E-mail: ghzadeh@ut.ac.ir