

Aiying Zhang

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School of Data Science, University of Virginia

ACADEMIC APPOINTMENTS

Assistant Professor of Data Science (tenure-track) School of Data Science, University of Virginia	AUG 2023 – PRESENT
Faculty Member , UVA Brain Institute	AUG 2023 – PRESENT

RESEARCH INTERESTS

My research interests span in the field of mental health data science, with a focus on developing statistical and computational approaches leveraging multi-modal imaging and genetics to understand typical and atypical brain development.

- Methods: Graphical Models (Directed/Undirected), Multimodal Fusion, Machine Learning
- Data types: MRI, DTI, fMRI, MEG, SNP, DNA methylation
- Psychiatric Diseases: Schizophrenia, Alzheimer's disease, Obsessive-compulsive disorder, Anxiety disorders, etc.

EDUCATION

Columbia University	AUGUST 2023
Postdoc Training in Clinical Biostatistics and Psychiatry , COLUMBIA UNIVERSITY IRVING MEDICAL CENTER	
Tulane University	MAY 2021
Ph.D. in Biomedical Engineering , SCHOOL OF SCIENCE AND ENGINEERING	
University of Science and Technology of China (USTC)	JUN 2014
B.Sc. in Statistics , SCHOOL FOR THE GIFTED YOUNG	

RESEARCH EXPERIENCE

Research Scientist II, New York State Psychiatric Institute	July 2021 – Aug 2023
Research Assistant, Tulane University	Jan 2016 – May 2021
Research Assistant, University of Florida	Aug 2014 – Dec 2015

PUBLICATIONS

First or Corresponding Author	
Mutu, D., Ji, K., He, X., Lee, S., Sequeira, S., and Zhang, A. (2024, May). Associations Between Brain Connectivity and Psychiatric Symptoms in Children: Insights into Adolescent Mental Health. In 2024 Systems and Information Engineering Design Symposium (SIEDS) (pp. 36-41). IEEE.	
Zhang, A. , Wengler, K., Zhu, X., Horga, G., Goldberg, T. E., Lee, S., and Alzheimer's Disease Neuroimaging Initiative. (2024). Altered hierarchical gradients of intrinsic neural timescales in mild cognitive impairment and Alzheimer's disease. Journal of Neuroscience, 44(25).	
Zhang, A. , Zhang, G., Cai, B., Wilson, T. W., Stephen, J. M., Calhoun, V. D., and Wang, Y. P. (2024). A Bayesian incorporated linear non-Gaussian acyclic model for multiple directed graph estimation to study brain emotion circuit development in adolescence. Network Neuroscience, 1-27.	

- Zhang, A.**, Cai, B., Hu, W., Jia, B., Liang, F., Wilson, T. W., Stephen, J. M., Calhoun, V. D. and Wang, Y.-P. (2020). Joint Bayesian-incorporating estimation of multiple Gaussian graphical models to study brain connectivity development in adolescence. *IEEE transactions on medical imaging*. vol. 39, no. 2, pp. 357-365.
- Zhang, A.**, Fang, J., Hu, W., Calhoun, V. D., and Wang, Y.-P. (2019). A Latent Gaussian Copula Model for Mixed Data Analysis in Brain Imaging Genetics. *IEEE/ACM transactions on computational biology and bioinformatics*. vol. 18, no. 4, pp. 1350-1360.
- Zhang, A.**, Fang, J., Liang, F., Calhoun, V. D. and Wang, Y.-P.(2019). Aberrant Brain Connectivity in Schizophrenia Detected via a Fast Gaussian Graphical Model. *IEEE journal of biomedical and health informatics*. vol. 23, no. 4, pp. 1479-1489.
- Zhang, A.**, Zhang, G., Calhoun, V. D. and Wang, Y.-P. (2020, March). Causal brain network in schizophrenia by a two-step Bayesian network analysis. In *Medical Imaging 2020: Imaging Informatics for Healthcare, Research, and Applications* (Vol. 11318, p. 1131817). International Society for Optics and Photonics.
- Zhang, A.**, Calhoun, V. D. and Wang, Y.-P. (2019, March). Joint Gaussian copula model for mixed data with application to imaging epigenetics study of schizophrenia. In *Medical Imaging 2019: Imaging Informatics for Healthcare, Research, and Applications* (Vol. 10954, p. 109540R). International Society for Optics and Photonics.
- Zhang, A.**, Fang, J., Calhoun, V. D. and Wang, Y.-P. (2018, April). High dimensional latent Gaussian copula model for mixed data in imaging genetics. In *2018 IEEE 15th International Symposium on Biomedical Imaging (ISBI 2018)* (pp. 105-109).
- Zhang, A.**, Jia, B. and Wang, Y.-P. (2018, March). Tracking the development of brain connectivity in adolescence through a fast Bayesian integrative method. In *Medical Imaging 2018: Imaging Informatics for Healthcare, Research, and Applications* (Vol. 10579, p. 105790O). International Society for Optics and Photonics.

Co-Author

- Sun, L., **Zhang, A.**, and Liang, F. (2024). Time-varying dynamic Bayesian network learning for an fMRI study of emotion processing. *Statistics in Medicine*, 43(14), 2713-2733.
- Zhang, G., Cai, B., **Zhang, A.**, Tu, Z., Xiao, L., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y. P. (2022). Detecting abnormal connectivity in schizophrenia via a joint directed acyclic graph estimation model. *NeuroImage*, 260, 119451.
- Cai, B., Zhou, Z., **Zhang, A.**, Zhang, G., Xiao, L., J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2022) Functional connectomes incorporating phase synchronization for the characterization and prediction of individual differences. *Journal of Neuroscience Methods*, 372, 109539.
- Cai, B., Zhang, G., **Zhang, A.**, Xiao, L., Hu, W., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2021) Functional connectome fingerprinting: Identifying individuals and predicting cognitive functions using refined brain connectivity. *Human Brain Mapping* 42.9, 2691-2705.
- Hu, W., Meng, X., Bai, Y., **Zhang, A.**, Cai, B., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2021) Interpretable multimodal fusion networks reveal mechanisms of brain cognition. *IEEE Transactions on Medical Imaging*, vol. 40, no. 5, pp. 1474-1483.
- Xiao, L., **Zhang, A.**, Cai, B., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2021) Correlation Guided Graph Learning to Estimate Functional Connectivity Networks from fMRI Data. *IEEE Transactions on Biomedical Engineering*, vol. 68, no. 4, pp. 1154-1165.
- Zhou Z., Cai, B., Zhang, G., **Zhang, A.**, Calhoun, V. D. and Wang, Y.-P. (2021) Prediction and classification of sleep quality based on phase synchronization related whole-brain dynamic connectivity using resting state fMRI. *NeuroImage*, 221, 117-190.

- Cai, B., Zhang, G., **Zhang, A.**, Hu, W., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2020). A GICA-TVGL framework to study sex differences in resting state fMRI dynamic connectivity. *Journal of Neuroscience Methods*, 332, p.108531.
- Cai, B., Zhang, G., Hu, W., **Zhang, A.**, Zille, P., Zhang, Y., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2019). Refined measure of functional connectomes for improved identifiability and prediction. *Human brain mapping*, 40(16), pp.4843-4858.
- Zhang, G., Cai, B., **Zhang, A.**, Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2020). Estimating Dynamic Functional Brain Connectivity with a Sparse Hidden Markov Model. *IEEE transactions on medical imaging*, vol. 39, no. 2, pp. 488-498.
- Hu, W., **Zhang, A.**, Cai, B., Calhoun, V. D. and Wang, Y.-P. (2019). Distance canonical correlation analysis with application to an imaging-genetic study. *Journal of Medical Imaging*, 6(2), 026501.
- Hu, W., Cai, B., **Zhang, A.**, Calhoun, V. D. and Wang, Y.-P. (2019). Deep collaborative learning with application to multimodal brain development study. *IEEE Transactions on Biomedical Engineering*, 66(12), 3346-3359.
- Cai, B., Zhang, G., **Zhang, A.**, Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2018). Capturing dynamic connectivity from resting state fMRI using time-varying graphical LASSO. *IEEE Transactions on Biomedical Engineering*, 66(7), 1852-1862.
- Zhang, G., **Zhang, A.**, Calhoun, V. D. and Wang, Y.-P. (2020, February). A causal brain network estimation method leveraging Bayesian analysis and the PC algorithm. In *Medical Imaging 2020: Biomedical Applications in Molecular, Structural, and Functional Imaging* (Vol. 11317, p. 113170X). International Society for Optics and Photonics.

Accepted

- Ji, C., Lee, S., Sequeira, Jin, J., **Zhang, A.** Leverage multi-modal neuro-imaging and genetics to identify causal relationship between structural and functional connectivity and ADHD with Mendelian randomization. Accepted by SPIE Medical Imaging.
- Solomon, A. Yu, E., Rasero, J., **Zhang, A.** Altered hierarchical rank in intrinsic neural time-scales in autism spectrum disorder. Accepted by SPIE Medical Imaging.
- Wang, S., Lei, Z., Tan, Z., Ding, J., Zhao, X., Dong, Y., Wu, G., Chen, T., Chen, C., **Zhang, A.**, Li, J. BrainMAP: Learning Multiple Activation Pathways in Brain Networks. Accepted by AAAI 2025.

Under Review

- Yu, W., Qu, G., Xu, L., **Zhang, A.** GAE-BEG Model: a Novel GNN Framework Integrating Neuroimaging and Behavioral Information to Understand Adolescent Psychiatric Disorders. Submitted to 2025 IEEE ISBI.
- Qu, G., Zhou, Z., Calhoun, V. D., **Zhang, A.**, and Wang, Y. P. (2024). Integrated Brain Connectivity Analysis with fMRI, DTI, and sMRI Powered by Interpretable Graph Neural Networks. Revision submitted to *Medical Image Analysis*. ArXiv, arXiv-2408.
- Cao, R., Li, X., Qu, G., **Zhang, A.**, and Wang, Y. P. Dual Attention Multi-View Multi-Task Learning for Cognitive Prediction from Brain Functional Connectivity, submitted to *IEEE Transactions on Biomedical Engineering*.

Under Preparation

- Ji, C., Lee, S., Sequeira, S., Jin, J., **Zhang, A.** Understanding the causal impact of structure-function coupling on ADHD using Mendelian randomization
- Zhang, A.**, Pagliaccio, D., Marsha, R., Lee, S. Decoding Age-specific Changes in Brain Functional Connectivity Using a Sliding-window Based Clustering Method. Submitted to *Human Brain Mapping*.
- Zhang, A.**, Wang, Y., Hu, N., Ye, C. ConnectMVR: A Supervised Multimodal Brain Connectivity Analysis Tool for Predicting Clinical Outcomes and Identifying Associated Connectivity Patterns

TEACHING

Instructor , School of Data Science	University of Virginia
DS 6013 : Data Science Capstone Project Work II	2024 SPRING
Teaching Assistant , Department of Biostatistics	University of Florida
Biostatistical Computing with SAS	2015 FALL
Advanced Biostatistical Methods	2015 FALL

MENTORING

University of Virginia	
Dongyuan Mutu, Statistics, Undergraduate	FALL 2023 - CURRENT
Jiajia Xu, Statistics, Undergraduate	FALL 2023 - CURRENT
Kurt Ji, Computer science, Master	FALL 2023 - CURRENT
Aroosha Solomon, Biology, Undergraduate [DMP]	FALL 2023 - CURRENT
Sudeshna Vankina, Psychology, Undergraduate	FALL 2023 - CURRENT
Ellery Yu, Computer science, Master	SPRING 2024 - CURRENT
Lucie Shichman, Data Science, Master	FALL 2024 - CURRENT
Farah Turkistani, Data Science, Master	FALL 2024 - CURRENT
Mackenzie Bullock, Data Science, Undergraduate [USOAR]	FALL 2024 - CURRENT
Chole Wang, Computer Science, Undergraduate [USOAR]	FALL 2024 - CURRENT
Zhenyu Lei, Electrical and Computer Engineering, PhD [with Jundong Li]	FALL 2024 - CURRENT
Yunfan Wang, Computer Science, PhD [with Chen Chen]	FALL 2024 - CURRENT
Tulane University , Department of Biomedical Engineering	
Student: Jason Dent, Biomedical Engineering, Undergraduate	2018

PRESENTATIONS

Invited Talk

UVA Statistics Department Colloquium, Nov 21, 2024.

Graph-Based Integration of Multimodal Neuroimaging to Decipher Neural-Behavioral Mechanisms

UVA Psychology Department Design and Data Analysis (DADA) meetings, Nov 14, 2024

Understanding the Causal Impact of Structure–Function Coupling on ADHD Using Mendelian Randomization

Neuroscience Clinical Research Interest Group, UVA Brain Institute, Oct 25, 2024.

Introduction of Data Science Techniques in Neuroscience Research – A Novel Integrative Framework for Longitudinal Multimodal Data Analysis

Neurodevelopmental Research Retreat, UVA Brain Institute, Oct 15, 2024.

Integrating Data Science to Neurodevelopmental Research

Brain in Data Science Symposium at School of Data Science, University of Virginia, Oct 14, 2024.

Graphical Models for Multimodal MRI Analysis

WNAR 2024, Fort Collins, CO, Jun 11, 2024.

A Graph Neural Network Approach to Integrate Multimodal Brain Imaging

Institute of Automation, Chinese Academy of Sciences, Virtual, December 28, 2023.

Revealing Connectomics Development and its Effect on Cognition By Leveraging Multimodal Brain Imaging and Genetics

WNAR 2023, Anchorage, AK, Jun 19, 2023.

A Highdimensional multiexposure mediation model to unravel brain structure-functional interactions

School of Data Science, Charlottesville, VA, March 24, 2023.

Study Brain Functional Connectivity Development In Adolescence Using Graphical Models

ENAR 2023, Nashville, TN March 21, 2023.

A High-dimensional multi-exposure mediation model to unravel brain structure-functional interactions

ImgFun workshop at Colorado University Biostatistics, Virtual, Mar 16, 2023.

A Joint Directed Acyclic Graph Estimation Model to Detect Aberrant Brain Connectivity in Schizophrenia

Department of Statistics at University of Kentucky, Oct 28, 2022, Lexington, KY

A Joint Directed Acyclic Graph Estimation Model to Detect Aberrant Brain Connectivity in Schizophrenia

Department of Psychiatry at University of Pittsburgh, Virtual, Mar 17, 2021.

Study Brain Functional Connectivity Using Graphical Models

Department of Electrical and Computer Engineering at Rice University, Virtual, Jan 12, 2021.

Study Brain Functional Connectivity Using Graphical Models

Mental Health Data Science at Columbia University, Virtual, Jan 8, 2021.

Study Brain Functional Connectivity Development in Adolescence Using Graphical Models

Department of Biostatistics at Columbia University, Virtual Presentation, Dec 3, 2020.

A Latent Gaussian Copula Model for Data Integration and Its Application in Imaging Genetics

The Cole Neurocognition Lab at Rutgers University, Virtual Presentation, Nov 23, 2020.

Study Brain Functional Connectivity Using Graphical Models

Contributed Presentations

AAIC 2024, Philadelphia, July 29, 2024.

Exploring hierarchical gradients of intrinsic neural timescales in mild cognitive impairment and Alzheimer's disease

ABCD Insights and Innovations Meeting, NIH campus, Bethesda, Mar 4-5, 2024.

Structure-function Coupling Variations in Human Brain Networks Underlying Psychiatric Comorbidity

Med-Neurips, New Orleans, Dec 16, 2023

Exploring General Intelligence via Gated Graph Transformer in Functional Connectivity Studies

OHBM Annual Meeting, Virtual Presentation, Jun 6 - 7, 2022

Decoding Age-specific Changes in Brain Functional Connectivity Using a Sliding-window Based Clustering Method

9th Annual Tom R. Ten have Symposium on Statistics in Mental Health, Jun 3, 2022, New York, NY, USA.

New Advances in Statistics and Data Science, May 25, 2022, Honolulu, HI, USA.

A Sliding-window based Clustering Method to Decode Age-Specific Changes in Brain Functional Connectivity

Joint Statistical Meetings (JSM), Virtual Presentation, August 4th, 2020.

A Bayesian Incorporated Linear Non-Gaussian Acyclic Model (BiLiNGAM) for Multiple Directed Acyclic Graph Estimation with application to causal brain connectivity using fMRI (#313970)

OHBM Annual Meeting, Virtual Presentation, June 23 - July 3, 2020.

Causal functional brain network: An advanced approach to study brain cognitive variance (#1068)

SPIE Medical Imaging, Feb 17, 2020, Houston, TX, USA.

Estimation of a causal brain network in schizophrenia via a two-step Bayesian network analysis (#11318-40)

SPIE Medical Imaging, Feb 18, 2019, San Diego, CA, USA

Joint Gaussian copula model for mixed data with application to imaging epigenetics study of schizophrenia (#10954-26)

IEEE ISBI 2018, Apr 5, 2018, Washington, D.C., USA

High dimensional latent Gaussian copula model for mixed data in imaging genetics (#551)

SPIE Medical Imaging, Feb 14, 2018, Houston, TX, USA

Tracking the development of brain connectivity in adolescence through a fast Bayesian integrative method (#10579-20)

OHBM Annual Meeting, June 28, 2017, Vancouver, BC, CA.

Discovery of aberrant brain connectivity networks associated with Schizophrenia using a high-dimensional Gaussian Graphical Model (#4028)

Campus Presentations

School of Science and Engineering (SSE) Research Day, April 11, 2019

High Dimensional Latent Gaussian Copula Model for Mixed Data in Imaging Genetics

Tulane Health Sciences Research Days (HSRD), Feb 20-21, 2017

Discovery of Aberrant Brain Connectivity in Schizophrenia using Gaussian Graphical Models

SSE Research Day, April 6, 2017

Discovery of Aberrant Brain Connectivity in Schizophrenia using Gaussian Graphical Models

SERVICE

To University

Brain Symposium Poster Judge	MARCH, 2024
USOAR Mentor: Chole Wang, Mackenzie Bullock	2024-2025
DMP Mentor: Amy Chang, Aroosha Solomon	2024-2025

To School

BSDS Faculty Mentor: 9 students	2024-2025
Qualification Exam Committee Chair: Guangya Wan, Mengxuan Hu	2024-2025
SDS T3 Search Committee: Health Data Science Subcommittee	2024-2025
Organizing <i>Brain in Data Science Symposium</i>	Nov 2024

To Profession

Review Editor for <i>Frontiers in Neuroscience</i> , <i>Frontiers in Neurology</i> and <i>Frontiers in Neuroimaging</i>	2024 - CURRENT
NSF Reviewer	2024, 2025
Reviewer for Israel Science Foundation	2025
Reviewer for Pacific Symposium on Biocomputing (PSB)	2025
Reviewer for OHBM Annual Meeting	2024
Reviewer for IEEE International Symposium on Biomedical Imaging (ISBI)	2024
Abstract Triage for the Neuromatch Conference	2020
Editorial Coordinator of Technometrics, American Statistician Association (ASA).	2015
Reviewer for <i>Nature Methods</i>	
Reviewer for <i>IEEE transactions on Medical Imaging (TMI)</i> , <i>IEEE transactions on Pattern Analysis and Machine Intelligence (PAMI)</i> , <i>IEEE transactions on Network Science and Engineering (TNSE)</i> , <i>IEEE/ACM transactions on Computational Biology and Bioinformatics (TCBB)</i>	
Reviewer for <i>Medical Image Analysis (MedIA)</i> , <i>Imaging Neuroscience</i> , <i>Brain Imaging and Behavior</i> , <i>Brain Structure and Function</i>	

OUTREACH ACTIVITIES

Woman in Neuroscience	2019
Volunteer of K-12 STEM Education Outreach	2017

RESEARCH GRANT SUPPORT

Funded Project at UVA

1. UVA Brain Institute Transformative Neuroscience Pilot Grant. Investigating anxiety-related variability in brain structure-function coupling during adolescence, \$50,000, 05/15/2024-06/30/2025, Role: Co-PI.
2. R01AG082228 (PI: Gary E Gibson), Mechanistic links between the benefits of pharmacologically high thiamine (vitamin B1) in Alzheimer's disease to Advanced Glycation Endproducts (AGE), \$6,156,917, 02/2024-01/2029, Role: Co-I.

Funded Projects at Columbia and NYSPI

1. NIH R01MH124106 (PI: Ying Liu) A Data Science Framework for Empirically Evaluating and Deriving Reproducible and Transferrable RDoC Constructs in Youth, \$3,351,397, 09/01/2020-06/30/2025, Role: Data Analyst
2. NIH R01AG062578 (PI: Seonjoo Lee) Statistical method for neural mechanism mediating and moderating cognitive system in Alzheimer's disease and aging research, \$2,086,831, 01/15/2020-12/31/2024, Role: Data Analyst

Funded Projects at Tulane

1. NIH R01MH121101, (PI: Tony Wilson) Developmental Multimodal Imaging of Neurocognitive Dynamics (Dev-MIND), 08/19/2019 – 05/31/2024, \$5,783,563 , Role: Graduate Research Assistant
2. NIH R01GM109068 (PI: Yu-Ping Wang) Integration of multiscale genomic data for comprehensive analysis of complex disease, \$1,608,775, 09/17/2014 – 08/31/2019, Role: Graduate Research Assistant
3. NSF 1539067, (PI: Vince Calhoun) RII Track-2 FEC: Developmental Chronnecto-Genomics (Dev-CoG): A Next Generation Framework for Quantifying Brain Dynamics and Related Genetic Factors in Childhood, \$5,858,210.00, 08/01/2015-07/30/2019, Role: Graduate Research Assistant
4. NIH R01MH104680, (PI: Yu-Ping Wang) Integration of brain imaging with genomic and epigenomic data, \$2,071,571, 08/01/2014 - 07/31/2018, Role: Graduate Research Assistant

HONORS AND REWARDS

IEEE Transactions on Medical Imaging (TMI) Distinguished Reviewer,	2024
ISBI 2024 Outstanding Reviewers,	2024
2021 Chinese Government Award for Outstanding Self-financed Students Abroad, China Scholar Council	2022
2021 Biomedical Engineering Graduate Student Outstanding Achievement Award, Tulane University	2021
GSSA Travel Award, Tulane University	2017 – 2020
Certificate of Outstanding Academic Achievement, University of Florida	2014 – 2015
Outstanding Student Scholarship , USTC	2011 – 2013
Outstanding Freshman Scholarship, USTC	2010

RELATED TRAINING

SHARP Training Program: Skills for Health and Research Professionals	AUG 11-12, 2022
Organization: Columbia University Mailman School of Public Health	
Certification: Mendelian Randomization Boot Camp: A Practical Guide to Study Design and Implementation	
Deep Learning by deeplearning.ai	MARCH 22, 2019
Platform: Coursera	
Biostatistics Summer Institutes in Statistical Genetics (SISG) and Statistics in Big Data (SISBID)	JULY 11-29, 2016

Organization: University of Washington, Seattle

Certification: Completion of *Quantitative Genetics* and *Supervised Methods for Statistical Machine Learning*

CCNS: Computational Neuroscience Summer School

JULY 27-31, 2015

Organization: The Statistical and Applied Mathematical Sciences Institute (SAMSI)

MEMBERSHIP

Member of American Statistician Association (ASA).	2015 – PRESENT
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Member of SPIE, the international society for optics and photonics	2018 – PRESENT
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SKILLS

Languages C/C++, Fortran, Matlab, Python, R, SAS, SPSS, SQL, STATA	Tools Linux/Unix, \LaTeX
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