

# **Benjamin Snow Sipes**

Oakland, CA  
619-647-0376  
benjamin.sipes@ucsf.edu || bensipes@gmail.com

**RESEARCH INTEREST:** My work applies spectral graph theory to decompose the brain network into spatial patterns, known as “brain harmonics,” to better understand the brain’s structural and functional networks in development, aging, and disease. I have found that these harmonics form distinct regimes related to integration and segregation in the brain and disentangle subject-specific from shared features.

---

## **EDUCATION:**

*In Progress:* **Ph.D. Bioengineering**, University of California, San Francisco & UC Berkeley.  
2019: **M.Sc. Biomedical Imaging**, University of California, San Francisco. [GPA: 3.88]  
2017: **B.Sc. Animal Biology**, Sociology minor, Professional Writing minor, University of California, Davis. [GPA: 3.43]

---

## **RESEARCH EXPERIENCE:**

July 2021-Present	<b>Assistant Specialist/Graduate Student Researcher.</b> Dr. Ashish Raj, <i>UCSF</i> Implement image processing pipelines for brain network analysis. Use MRI and MEG data to study brain structure-function relationships in clinical populations.
Sept. 2019-July 2022	<b>Assistant Specialist.</b> Dr. Olga Tymofiyeva & Dr. Tony Yang, <i>UCSF</i> Design and implement image processing pipelines for brain network analysis. Identify brain network correlates of mindfulness and prosocial behavior. Coordinate NIH R61 clinical trial with healthy adolescents and parents. Collect psychometric data.
Sept. 2018-Sept. 2019	<b>Research Volunteer.</b> Dr. Adam Gazzaley & Dr. Courtney Gallen, <i>Neuroscape UCSF</i> Used EEGLAB to perform microstate analysis during a BCI task. Collected EEG and MRI data in adolescent participants. Administered behavioral and cognitive exams.
June 2017-February 2018	<b>Research Assistant.</b> Dr. Brenda McCowan, <i>UC Davis School of Veterinary Medicine</i> Studied rhesus macaque social networks, dynamics, and human conflict in Shimla, India. Live behavioral scoring of over 100 rhesus macaque individuals. Social network analysis with Cytoscape. Data quality control. Data querying in Microsoft Access.
October 2014-March 2016	<b>Assistant Team Leader/Research Assistant.</b> Dr. Karen Bales, <i>UC Davis CNPRC</i> Studied the role of oxytocin in titi monkeys, a monogamous primate. Collected biological specimens for analysis. Filmed and scored primate behavior. Trained titi monkeys.

---

## **CURRENT PROJECTS:**

**Uncovering the brain’s network asymmetry with the higher-order network diffusion model**  
Diffusion MRI tractography is widely used to estimate structural connectivity (SC) between brain regions *in vivo*, but it lacks directional information about white matter pathways. I have used a higher-order network diffusion model to estimate the asymmetry in SC that best explains fMRI brain activity. Using the CoCoMac open-source database as a ground-truth for directionality in non-human primates, I found that my method can accurately recover SC directionality using fMRI in 9 non-human primates.

### **Filtering Out the Effects of Network Diffusion in the Brain’s Functional Signals**

Signal originating from brain function is a mixture of many components, many of which obscure the signal of greatest interest. One such component to the brain’s signal of lesser interest is the effect of passive signal diffusion through the brain’s structural network. This project aims to filter out this signal such that what remains is more precisely related to active signal transport related to cognition.

### **Modeling Brain Dynamics in Alzheimer's Disease with the Spectral Graph Model:**

The Spectral Graph Model (SGM) is a biophysical model that uses the brain’s graph harmonics, and it has shown marked differences between Alzheimer’s Disease (AD) and age-matched controls. We test if SGM fit dynamically can extend our understanding of AD with dynamic differences in SGM parameters.

### **SKILLS:**

- Writing: abstracts, reviews, grant proposals, primary research, science journalism
- Programming: MATLAB, Python, computational modeling, machine learning
- Research: study design, good clinical practice, study documentation, IRB compliance

### **PROFESSIONAL SOCIETIES:**

The Society for Neuroscience; The Organization of Human Brain Mapping; The Organization for Computational Neuroscience; International Society for Magnetic Resonance in Medicine

### **AWARDS:**

**Best Poster Presentation Award**, 18th Annual Radiology and Biomedical Imaging Research Symposium, UCSF

**Best Neuroimaging Poster Award**, UCSF Radiology Research Conference, 2025

---

### **PUBLICATION LIST:**

#### **Journal articles**

Raj, A., **Sipes, B. S.**, Verma, P., Mathalon, D. H., Biswal, B., & Nagarajan, S. (2024). Spectral graph model for fMRI: A biophysical, connectivity-based generative model for the analysis of frequency-resolved resting-state fMRI. *Imaging Neuroscience*, 2, 1-24. [https://doi.org/10.1162/imag\\_a\\_00381](https://doi.org/10.1162/imag_a_00381)

**Sipes, B.S.**, Nagarajan, S.S. & Raj, A. Integrative, segregative, and degenerate harmonics of the structural connectome. *Commun Biol* 7, 986 (2024). <https://doi.org/10.1038/s42003-024-06669-6>

Tymofiyeva O\*, **Sipes BS\***, Luks T, Hamlat EJ, Samson TE, Hoffmann TJ, Glidden DV, Jakary A, Li Y, Ngan T, Henje E and Yang TT (2024) Interoceptive brain network mechanisms of mindfulness-based training in healthy adolescents. *Front. Psychol.* 15:1410319. doi: 10.3389/fpsyg.2024.1410319 **\*co-first authors**

**Sipes, B. S.\***, Verma, P.\*, Ranasinghe, K., Nagarajan, S.S., Raj, A. (*in preparation*). Spectral graph dynamics of MEG predicts abnormal neural oscillations and cognitive deficits in Alzheimer's disease. **\*co-first authors**

**Sipes, B. S.**, Jakary, A., Li, Y., Max, J. E., Yang, T. T., & Tymofiyeva, O. (2022). Resting state brain subnetwork relates to prosociality and compassion in adolescents. *Frontiers in Psychology*, 13, 1012745. <https://doi.org/10.3389/fpsyg.2022.1012745>

**Sipes, B. S.**, Yang, T. T., Parks, K. C., Jariwala, N., & Tymofiyeva, O. (2022). A Domain-General Developmental “Do-GooD” Network Model of Prosocial Cognition in Adolescence: A Systematic Review. *Frontiers in Behavioral Neuroscience*, 16.

Cummings, J. A., **Sipes, B.**, Mathalon, D. H., & Raj, A. (2022). Predicting Functional Connectivity From Observed and Latent Structural Connectivity via Eigenvalue Mapping. *Frontiers in Neuroscience*, 16.

Tymofiyeva, O., Hu, M. Y., **Sipes, B. S.**, Jakary, A., Glidden, D. V., Jariwala, N., ... & Yang, T. T. (2022). A Feasibility Study of a Remotely-Delivered Mindfulness-Based Training for Adolescents During the COVID-19 Pandemic. *Frontiers in Psychiatry*, 645.

Tymofiyeva O, Henje E, Yuan JP, Huang CY, Connolly CG, Ho TC, Bhandari S, Parks KC, **Sipes BS**, Yang TT, Xu D. Reduced anxiety and changes in amygdala network properties in adolescents with training for awareness, resilience, and action (TARA). *Neuroimage Clin.* 2021;29:102521. doi: 10.1016/j.nicl.2020.102521. Epub 2020 Dec 3. PMID: 33316764; PMCID: PMC7735968.

### **Conference contributions**

**Sipes, B. S.,** Raj, A. Deconvolving Passive Diffusion on the Structural Network from Functional Brain Signals. International Society for Magnetic Resonance in Medicine, 2025.

**Sipes, B. S.,** & Raj, A. (2025, April). Deconvolving Passive Diffusion on the Structural Network from Functional Brain Signals. In 2025 IEEE 22nd International Symposium on Biomedical Imaging (ISBI) (pp. 1-5). IEEE.

**Sipes, B. S.,** Verma, P., Nagarajan, S.S., Raj, A. Integrative, Segregative, and Degenerate Harmonics of the Structural Connectome. The Organization for Computational Neuroscience, 2023.

**Sipes B,** Jakary A, Morrison M, Yang TT, Tymofiyeva O. Resting state functional connectivity subnetwork relates to prosocial behavior and compassion in adolescents. International Society for Magnetic Resonance in Medicine, 2022.

Khanna, S., Johnson, A., Lyons, I., **Sipes, B.,** Tymofiyeva, O., Lupo, J.M., Ostrem, J., Wang, D., Starr, P., Bledsoe, I., Morrison, M. Preoperative 7T MRI relates to levodopa dose reduction after chronic deep brain stimulation for Parkinson's disease. International Society for Magnetic Resonance in Medicine, 2022.

**Sipes B,** Jakary A, Morrison M, Yang TT, Tymofiyeva O. Resting state functional connectivity subnetwork relates to prosocial behavior and compassion in adolescents. 18th Annual Radiology and Biomedical Imaging Research Symposium, UCSF, San Francisco, CA, 2021.

**Sipes B,** Nguyen C, Parks K, Jariwala N, Li Y, Yang TT, Tymofiyeva O. Temporal-parietal junction structural connectivity and adolescent prosocial behavior. Organization for Human Brain Mapping, 2021.

Tymofiyeva O, Hu M, **Sipes B,** Jariwala N, Jakary A, Nguyen C, Parks K, Henje E, Yang TT. A Randomized Controlled Feasibility Study of Emotional Well-being of Adolescents Undergoing a Mindfulness Training During COVID-19. American Academy of Child and Adolescent Psychiatry, 2021.

Tymofiyeva O, Huang C-Y, Bhandari S, Lopez E, Parks K, Jariwala N, **Sipes B,** Yang TT. Childhood trauma and amygdala-orbitofrontal anatomical connectivity in adolescents. Proc. of the American Academy of Child and Adolescent Psychiatry, Montreal, San Francisco, CA, 2020.

**Sipes B,** Nguyen C, Parks K, Jariwala N, Yang TT, Tymofiyeva O. Structural Default Mode Network (DMN) Connectivity and Adolescent Prosocial Behavior. 17th Annual Radiology and Biomedical Imaging Research Symposium, UCSF, San Francisco, CA, 2020.

### **Master's Thesis**

**Sipes, B.** EEG Microstates in Neurofeedback Attention Training. University of California, San Francisco, 2019.