

# William F. Broderick

✉ [billbrod@gmail.com](mailto:billbrod@gmail.com)  
🌐 <https://wfbroderick.com>  
🌐 [William Broderick](#)  
🐦 [@wfbroderick](#)  
🌐 [billbrod](#)

## Education

- 2016 – 2022 **Ph.D.**, *New York University*, New York, NY.  
Center for Neural Science
- 2009 – 2013 **B.A.**, *Oberlin College*, Oberlin, OH, *GPA: 3.94*.  
Majors: Neuroscience, Mathematics; Minor: Computer Science
- Spring 2012 **Budapest Semester in Mathematics**, Budapest, Hungary, *GPA: 4.07*.  
High Honors

## Professional Experience

- September 2023 – present **Associate Research Scientist – Software**, *Flatiron Institute Center for Computational Neuroscience*, New York, NY.
- present Prof. Eero Simoncelli, Ph.D.
- Core developer of **plenoptic**, a python package for model understanding and comparison via image synthesis.
  - Developer of **nemos**, a statistical modeling framework for neuroscience.
  - Assisted with CCN's other python packages and related projects.
  - With the rest of the **NeuroRSE** team, developed and ran workshops to teach scientists how to use the python packages developed at CCN.
  - Served as a member of CCN's Computing Committee, interfacing between the center's researcher's and the Scientific Computing Core, which runs Flatiron's high performance computing cluster.
  - Served as a member of **Sciware's** Organizing Committee, organizing Flatiron-wide events to teach scientists about various software- and computing-related topics.

## Research Experience

- June – November, 2019 **Research Intern**, *Facebook Reality Labs*, Redmond, WA.
- November, 2019 Dr. Gizem Rufo, Ph.D.
- Implemented foveated luminance and spectral energy models in PyTorch.
  - Generated *metameric images* for these models. Metamers are images that are physically distinct (i.e., have different pixel values) but produce identical system outputs. For the human visual system, this would be two images that are physically distinct but perceptually identical.
  - Found best-fitting parameter values and validated the models by using these metamers in a psychophysical experiment.

- 2016 – 2022 **Ph.D. Student**, *New York University Center for Neural Science*, New York, NY.  
Prof. Eero Simoncelli, Ph.D. and Prof. Jonathan Winawer, Ph.D.
- Built parametric model summarizing how spatial frequency preferences change across the visual field in human primary visual cortex.
  - Investigated spatial information discarded by human visual system using foveated model metamers.
  - Developed **plenoptic**, a python package for model understanding and comparison via image synthesis.
- 2014 – 2016 **Research Assistant**, *Duke University Center for Cognitive Neuroscience*, Durham, NC.  
Prof. Scott Huettel, Ph.D. and Prof. Guillermo Sapiro, Ph.D.
- Created a pre-processing pipeline for fMRI data in Python, making lab methods simpler and more user-friendly
  - Performed multi-variate pattern analysis (MVPA) on fMRI data in a social, competitive game in order to investigate the neural correlates of social decision making and deception (Python)
  - Analyzed behavioral data of participant behavior in a social, competitive game, making use of k-means clustering and principal components analysis (PCA) to define a trial-wise metric of strategic behavior for use in MVPA regression
  - Collected behavioral and functional imaging data from adult and adolescent participants in a study to investigate the effects of social signals and peer influence on risk-taking and reward processing
  - Supervised undergraduate research assistants for the collection of the above data
- 2013 – 2014 **Luce Scholar**, *South China Normal University School of Psychology*, Guangzhou, China.  
Prof. Wang Suiping, Ph.D.
- *Selected by the Luce Scholars Program, a nationally competitive fellowship program launched by the Henry Luce Foundation in 1974 to enhance the understanding of Asia among potential leaders in American society. The program selects 18 scholars annually and arranges individualized language training and professional placement for one year*
  - Managed two independent research projects as a full-time visiting scholar
  - Extended a computational model of numerosity using deep learning in an artificial neural network (MATLAB/Octave). Modified earlier study's code to allow for training on different tasks to compare the encoding strategy employed by the network
  - Analyzed fMRI data comparing the network properties of human brain functional networks during bilingual readings. Preprocessed and analyzed data in MATLAB, using original code, DPARSF, and functions from Gretna and Brain Connectivity Toolboxes
- 2011 – 2013 **Undergraduate Research Assistant**, *Oberlin College Neuroscience Department*, Oberlin, OH.  
Prof. Patrick Simen, Ph.D.
- Enhanced previously-developed model explaining reaction time in a two-alternative forced choice task in response to varying response-stimulus intervals and probability of the two choices (MATLAB)
  - Updated model code in MATLAB to explain recently-gathered experimental data with model

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## Other Activities

- 2019 – **Core developer**, *plenoptic*.
- present
- Developed and maintained **plenoptic**, a python package for model understanding and competition using image synthesis.
  - Wrote code, documentation, tutorials, and tests for the package, particular focusing on metamer and MAD competition, as well as functions for displaying and animating images.
  - Worked collaboratively with the other core developers, all members of the Simoncelli lab, to determine direction for the package.
  - Reviewed pull requests, provided feedback on others' code, documentation, and tutorials.
- 2016 – 2021 **Member**, *Scientist Action and Advocacy Network*, New York, NY.
- Along with two other developers and in collaboration with NYC Environmental Justice Alliance, put together an **interactive map** visualizing the effects of climate change and storm surge on New York City's industrial waterfront. The map won first place in the mapping and visualization competition on NYU's DH + Data day 2018.
  - In collaboration with the Central Maryland Transit Alliance, developed python code to regularly ping the GTFS feeds of Baltimore's bus system to get real-time updates of their location and add it to a MySQL database. Other developers are working on visualizing and analyzing this data. We received credits from Google via their Google Cloud Research Credits to support the database.
- 2020 **Cohort member**, *Open Life Science*.
- Took part in cohort-based training on how to run an open science project.
  - Received personal mentorship in how to run an open source scientific software project.

## Awards and Scholarships

2016	NSF Graduate Research Fellow	<i>National Science Foundation</i>
2013 – 2014	Luce Scholar	<i>Henry Luce Foundation</i>
2013	Phi Beta Kappa	<i>Phi Beta Kappa Society</i>
2012	Nu Rho Psi	<i>National Honor Society in Neuroscience</i>
2009 – 2013	John N. Stern Merit Scholarship in the Natural Sciences	<i>Oberlin College</i>
2009	National Merit Scholar	<i>National Merit Scholarship Program</i>

## Publications

- Broderick, William F., Gizem Rufo, Jonathan Winawer, and Eero P. Simoncelli. "Foveated Metamers of the Early Visual System". In: *bioRxiv* (2023). DOI: [10.1101/2023.05.18.541306](https://doi.org/10.1101/2023.05.18.541306).
- Broderick, William F., Eero P. Simoncelli, and Jonathan Winawer. "Mapping Spatial Frequency Preferences Across Human Primary Visual Cortex". In: *Journal of Vision* 22.4 (2022), pp. 3–3.
- McDonald, Kelsey R., William F. Broderick, Scott A. Huettel, and John M. Pearson. "Bayesian Nonparametric Models Characterize Instantaneous Strategies in a Competitive Dynamic Game". In: *Nature Communications* 10.1808 (2019). URL: <https://doi.org/10.1038/s41467-019-09789-4>.

## Presentations

- Broderick, William F., Gizem Rufo, Jonathan Winawer, and Eero P. Simoncelli. *Foveated metamers of the early visual system (poster)*. Vision Sciences Society, June 2023. URL: <https://osf.io/8hdaz/>.

- Duong, Lyndon, Kathryn Bonnen, William Broderick, Pierre-Étienne Fiquet, Nikhil Parthasarathy, Thomas Yerxa, Xinyuan Zhao, and Eero Simoncelli. *Plenoptic: A platform for synthesizing model-optimized visual stimuli*. Vision Sciences Society, June 2023. DOI: [10.1167/jov.23.9.5822](https://doi.org/10.1167/jov.23.9.5822).
- Ha, Jiyeong, William Broderick, Kendrick Kay, and Jonathan Winawer. *Spatial Frequency Maps in Human Visual Cortex: A Replication and Extension*. Vision Sciences Society, June 2023. DOI: [10.1167/jov.23.9.5624](https://doi.org/10.1167/jov.23.9.5624).
- Broderick, William F., Gizem Rufo, Jonathan Winawer, and Eero P. Simoncelli. *Estimating scaling of retinal and cortical pooling using metamers*. Online: Vision Sciences Society, June 2020. URL: <https://osf.io/aketq/>.
- Broderick, William F., Noah C. Benson, Eero P. Simoncelli, and Jonathan Winawer. *Mapping Spatial Frequency Preferences in the Human Visual Cortex*. St Pete Beach, FL: Vision Sciences Society, May 2018. DOI: <http://dx.doi.org/10.17605/OSF.IO/KNJQY>.
- Benson, Noah C., William F. Broderick, Heiko Muller, and Jonathan Winawer. *An anatomically-defined template of BOLD response in V1-V3*. St Pete Beach, FL: Vision Sciences Society, May 2017. DOI: <https://doi.org/10.1167/17.10.585>.
- *From Retina to Extra-striate cortex: Forward Models of Visual Input; Toward a Standard Cortical Observer*. Invited talk. Optical Society of America, Oct. 2017.
- Benson, Noah C., Catherine Olsson, William F. Broderick, and Jonathan Winawer. *Towards a standard cortical observer model in human V1-V3*. San Diego, CA: Society for Neuroscience, Nov. 2016.
- Broderick, W. F., R. M. Carter, M. Tepper, J. F. Garipey, M. L. Platt, G. Sapiro, and S. A. Huettel. *A multi-variate pattern analysis investigation of strategic thinking and deception in a dynamic, competitive game*. Chicago, IL: Society for Neuroscience, Oct. 2015.