Isabelle Rosenthal, PhD

Current Research

I am a postdoc in Dr. Richard Andersen's neural prosthetics lab at Caltech. My research uses microelectrode arrays, virtual reality environments, and human data to understand how to reliably elicit artificial tactile sensations and how neural encodings inform multisensory perceptual experiences.

Education

California Institute of Technology, Pasadena, CA — Oct. 2018 – April 2023
PhD, Computation and Neural Systems Program
Thesis: "The representation of multimodal tactile sensations in the human somatosensory system"
Advisor: Richard Andersen
Chen Institute for Neuroscience Graduate Fellow; Bing Graduate Fellow

Wellesley College, Wellesley, MA — Sep. 2012 – May 2016
Bachelor of Arts with Honors in Neuroscience, *cum laude*
Honors Thesis: "A cognitive computational approach to understanding Theory of Mind and its impairment in Autism Spectrum Disorder"

Work Experience

Researcher — Oct. 2018 – present
California Institute of Technology, Pasadena, CA
- Designed, implemented, and collected data for electrophysiology experiments on the neural encoding of tactile information in multisensory contexts with MATLAB
- Preprocessed and analyzed human electrophysiology data using signal processing, machine learning, dimensionality reduction, and representational similarity analysis with MATLAB and Python
- Constructed lifelike Unity VR environments with animations, eye-tracking, and Unity-MATLAB communication
- Designed, 3D printed, and programmed an Arduino-based pressure sensor for logging tactile stimuli

Data Science Consultant — Jul. 2022 – Dec. 2022
Celero Systems, Lincoln, MA
- Designed and implemented a noise-removal algorithm and signal processing pipeline to extract respiratory and cardiac rates from an ingestible electronic device
- Designed and implemented an algorithm to detect levels of sleep apnea from respiratory data

Laboratory Manager — Jun. 2016 – Jul. 2018
Laboratory of Sensorimotor Research, National Institutes of Health, Bethesda, MD
- Published 3 papers on image statistics and the neural encoding of color vision
- Collected and analyzed human MRI, MEG, and eye-tracking data
- Trained and collected single-cell electrophysiology data and MRI data from macaque monkeys

Undergraduate Research Assistant — Sep. 2014 – May. 2016
California Institute of Technology, Pasadena, CA
Research mentors: Ralph Adolphs, Damian Stanley; Wellesley on-campus advisor: Bevil Conway
Amgen Scholar (Summer 2015)
Howard Hughes Medical Institute SURF Fellow (Summer 2014)
- Programmed a novel reinforcement learning task with optimized timings for MRI
- Collected and analyzed human behavioral and MRI data
- Produced a paper detailing a reinforcement learning model tracking Theory of Mind in Autism Spectrum Disorder and healthy controls

Teaching Experience

Teaching Assistant — Jan. – Mar. 2021; Jan. – Mar. 2023
CNS 247: Cerebral Cortex at the California Institute of Technology

Supplemental Instruction Leader — Aug. – Dec. 2016

NEUR 200: Neurons, Networks, and Behavior at Wellesley College
- ♦ Led twice-weekly review sessions, held office hours, wrote worksheets on course material, mentored students

Neuroscience Department Grader   Jan. 2014 – May. 2016
NEUR 200: Neurons, Networks, and Behavior at Wellesley College

Neuroscience Fellow   Jan. – May. 2014
Wellesley College Neuroscience Department
- ♦ Supervised students in three crayfish electrophysiology lab sessions; awarded honorarium

Leadership and Mentoring

Neurotechers President   Jun. 2020 – Jul. 2022
Led the Caltech Neurotechers club which builds community through academic and social programs. Drafted budgets, solicited funding, coordinated virtual and in-person events, and ran board meetings.

i-STEM Scholars Summer Research Mentor   Jun. – Aug. 2021
Mentored a high school student with a personalized Python coding project, biweekly meetings, and tutoring.

Women Mentoring Women Program Mentor   2019, 2020, 2022
Provided mentorship, regular meetings, and support to two first year graduate students and one undergraduate student.

CNS Seminar Series Coordinator   Oct. 2019 – Oct. 2020
Solicited suggestions from faculty and students, invited speakers to Caltech, and coordinated talks on behalf of the Computation and Neural Systems program.

Neurotechers Ask Me Anything Series Coordinator   Apr. 2019 – Jul. 2020
Planned, coordinated, and hosted Ask Me Anything events for the Caltech Neurotechers Club, in which students have an open forum to ask questions to professors.

i-STEM Scholars Summer Research Mentor   Jun. – Aug. 2021
Mentored a high school student with a personalized Python coding project, biweekly meetings, and tutoring.

Awards and Honors

Chen Diversity and Inclusion Award   Apr. 2021
For leadership in diversity and inclusion, and promoting equal opportunities at Caltech.

NSF Graduate Research Fellowship – Honorable Mention   Apr. 2019

Chen Institute for Neuroscience Graduate Fellowship   Oct. 2018
Awarded funding prize for the first year of graduate study at Caltech.

Bing Graduate Fellowship   Apr. 2018
Awarded funding prize for the first year of graduate study at Caltech.

NSF Graduate Research Fellowship – Honorable Mention   Apr. 2018

Hubel Thesis Writing Prize   May 2016
For an outstanding thesis in Neuroscience at Wellesley College.

Publications

Rosenthal, I., Bashford, L., Kellis, S., Pejsa, K., Lee, B., Liu, C., Andersen, R.A. (2023) S1 represents multisensory contexts and somatotopic locations within and outside the bounds of the cortical homunculus. Cell Reports 42(4), 112312. doi: 10.1016/j.celrep.2023.112312

Hermann, K.L.*, Singh, S.R.*, **Rosenthal, I.***, Pantazis, D., Conway, B.R. (2022) Temporal dynamics of the neural representation of hue and luminance polarity. Nat Commun 13, 1–19. doi: 10.1038/s41467-022-28249-0

Bashford, L., **Rosenthal, I.**, Kellis, S., Pejsa, K., Kramer, D., Lee, B., Liu, C., Andersen, R.A. (2021) The neurophysiological representation of imagined somatosensory percepts in human cortex. Journal of Neuroscience, doi:10.1523/JNEUROSCI.2460-20.2021

Rosenthal, I.*, Singh, S. R.*, Hermann, K. L.*, Pantazis, D., Conway, B. (2020) Color space geometry uncovered with magnetoencephalography. Current Biology, doi:10.1016/j.cub.2020.10.062

Rosenthal, I., Hutcherson, C., Adolphs, R., & Stanley, D. (2019) Deconstruction of Theory-of-Mind impairment in high functioning adults with Autism. Current Biology, 29(3): 513-519, doi:10.1016/j.cub.2018.12.039

Rosenthal, I., Ratnasingam, S., Haile, T., Eastman, E., Fuller-Deets, J., & Conway, B. (2018) Color statistics of objects and color tuning of inferior temporal cortex in macaque monkey. Journal of Vision, 18(1): 1-21, doi:10.1167/18.11.1

* denotes co-first authors

Talks and Posters

Rosenthal, I., Bashford, L., Kellis, S., Pejsa, K., Lee, B., Liu, C., & Andersen, R.A. (2023, February**). Biological relevance of visual stimuli modulates the temporal binding window between ICMS and vision**. Talk and poster to be presented at: 10th annual BCI Meeting in Brussels, Belgium.

Rosenthal, I., Bashford, L., Kellis, S., Pejsa, K., Lee, B., Liu, C., & Andersen, R.A. (2023, February**). The temporal binding window between ICMS and vision depends on biological relevance of stimuli**. Poster presented at: International Brain Stimulation Conference annual meeting in Lisbon, Portugal.

Rosenthal, I., Bashford, L., Kellis, S., Pejsa, K., Lee, B., Liu, C., & Andersen, R.A. (2022, November**). S1 represents multisensory contexts and somatotopic locations within and outside the bounds of the cortical homunculus**. Poster presented at: Society for Neuroscience annual meeting in San Diego, CA.

Rosenthal, I., Bashford, L., Kellis, S., Pejsa, K., Lee, B., Liu, C., & Andersen, R.A. (2022, November**). Exploring the effects of multisensory information in S1 within and outside the cortical homunculus**. Poster presented at: Human Single Neuron Conference annual meeting in Los Angeles, CA.

Rosenthal, I. (2022, November**). Constructing representations of touch in human somatosensory cortex.** Talk, Biology & Biological Engineering Retreat, Caltech, Pasadena, CA.

Rosenthal, I., Fuller-Deets, J., Haile, T., Eastman, S.C., Gruen, T., Tello, L., & Conway, B. (2018, November**). Color responses of face cells in alert macaque monkey**. Poster presented at: Society for Neuroscience annual meeting in San Diego, CA.

Rosenthal, I., Hermann, K., Vonder Haar, C., Pantazis, D., & Conway, B. (2017, November). **Decoding hue and luminance with magnetoencephalography**. Poster presented at: Society for Neuroscience annual meeting in Washington, D.C.

Rosenthal, I. (2016, April). **Theory of Mind and Learning Models: Unraveling How We Think About Others' Thoughts**. Talk, Rulhman Conference, Wellesley College, Wellesley, Massachusetts.

Rosenthal, I. (2014, April). **Impaired Theory of Mind in Autism may stem from disrupted computation of others' intentions.** Poster presented at: Social & Affective Neuroscience Society annual meeting in Boston, Massachusetts
- ♦ **Received SANS Poster Award for high quality of submission**

Rosenthal, I. (2014, October). **A cognitive computational approach to understanding Theory of Mind**. Talk, Tanner Conference, Wellesley College, Wellesley, Massachusetts.

Select Programming and Technical Skills

Expert proficiency in:
- ♦ MATLAB programming for data collection (Psychtoolbox), behavioral and neural data analysis, and figure generation
- ♦ Data processing including matrix manipulation, dimensionality reduction, SVD/PCA, and Gaussian Process Factor Analysis (GPFA)
- ♦ Applying and evaluating machine learning classifiers, including linear classifiers, clustering algorithms, and CNNs
- ♦ Tests of significance including bootstrapping, permutation tests, ANOVAs, and multiple comparisons corrections
- ♦ Representational Similarity Analysis (RSA) and Multi-Dimensional Scaling (MDS) for data analysis and visualization

Working proficiency in:
- ♦ Python programming for data analysis and figure generation (matplotlib)
- ♦ Signal processing including smoothing, convolution, band pass filters, Fourier transforms
- ♦ Computational vision models including convolutional and recurrent neural networks (CNNs, RNNs) and generative adversarial networks (GANs), using pyTorch and tensorFlow
- ♦ Unity and C# to construct realistic 3D animated environments, interface with MATLAB, and collect eye-tracking data
- ♦ Terminal commands (unix) and shell scripting
- ♦ Scheduling and running jobs on a computing cluster