Yarden Cohen - Curriculum Vitae

Contact Information

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Research Interests

Systems Neuroscience, Neuroethology, Complex Systems, Reinforcement Learning, Tool development, Motor Sequencing & Learning, Dynamical Systems, Electrophysiology, Neurophotonics.

Education

Weizmann Institute of Science, Feinberg Graduate School, Rehovot, Israel

Ph.D., Neurobiology, *January 2016*

- Advisors: **Rony Paz**, Ph.D and **Elad Schneidman**, Ph.D

Weizmann Institute of Science, Feinberg Graduate School, Rehovot, Israel

M.Sc., Physics, *February 2010*

- Advisor: **Elad Schneidman**, Ph.D

The Hebrew University, Jerusalem, Israel

B.Sc., Physics and Mathematics as part of the "Talpiot" excellence program of the Israeli Ministry of Defense and the Hebrew University, *June 2000*

Research Experience

Research Fellow May 2020 to Present
Williams Lab, Massachusetts General Hospital Department of Neurosurgery and Harvard Medical School
Research Summary: Use novel ultrahigh resolution microelectrode arrays to study the processes by which humans produce and comprehend language: project design, neuronal analysis and modeling, and manuscript writing.

Postdoctoral Associate January 2016 to April 2020
Gardner Lab, Boston University Department of Biology
Research Summary: (1) Adapted calcium imaging techniques to awake behaving canaries and studied neural coding of correlated song sequences. The key finding was that hidden network states support behavior transition syntax rules with long-range history dependence. (2) Deep neural network algorithms development - outperforming the state-of-the-art method for birdsong annotation. (3) Collaborated with the Cogan lab from UT Dallas to develop scalable ultramicroelectrode arrays for neural stimulation and recording.

Graduate Student October 2007 to January 2016
Paz and Schneidman labs, Weizmann Institute of Science Department of Neurobiology
Research Summary: Modeled human classification learning. Found that visual feature-based reinforcement learning models can capture, predict and be used to influence behavior - and boost learning. Trained monkeys on classification tasks and recorded single neurons while the animals learned new rules. Developed a novel projection of neural activity on visual features to discover different learning dynamics in cortex and striatum.

Work Experience

Project Manager October 2005 to December 2006
Israeli Ministry of Defense (M.O.D)
Work Summary: Electronics, communication, management.

Electronics Engineer February 2005 to October 2005
Israeli Ministry of Defense (M.O.D)
Work Summary: Electronic circuit development.

Head of acoustics research group April 2002 to February 2005
Israeli Ministry of Defense (M.O.D)
Work Summary: Measurements and simulation of wave propagation, psychoacoustics, electro-acoustics, research and development.

Journal Publications

1. **Cohen Y**, Shen J, Semu D, Leman DP, Liberti WA III, Perkins N, and Gardner TJ (2020) "Hidden neural states underlie canary song syntax" *Nature* 1-6 doi:10.1038/s41586-020-2397-3.

2. Deku F, Frewin C, Stiller A, **Cohen Y**, Aqeel S, Joshi-Imre A, Black B, Gardner TJ, Pancrazio JJ, and Cogan SF (2018) "Amorphous Silicon Carbide Platform for Next Generation Penetrating Neural Interface Designs". *Micromachines*, 9(10), 480.

3. Deku F, **Cohen Y**, Joshi-Imre A, Kanneganti A, Gardner TJ, and Cogan SF (2018) "Amorphous Silicon Carbide Ultramicroelectrode Arrays for Neural Stimulation and Recording". *J. Neural Eng.* 15, 016007.

4. **Cohen Y**, Paz R (2015) "It All Depends on the Context, but Also on the Amygdala". *Neuron* 87: 4: 67880. (Preview)

5. **Cohen Y**, Schneidman E (2013) "High-order feature-based mixture models of classification learning predict individual learning curves and enable personalized teaching". *Proc Natl Acad Sci USA* 110:684689.

Peer-Reviewed Conference Publications

1. **Cohen Y**, Shen J, Semu D, Otchy TM and Gardner TJ (2018) "Calcium imaging in canary (serinus canaria) HVC reveals latent states supporting behavioral sequencing with long range history dependence". *2018 Conference on Cognitive Computational Neuroscience* doi:10.32470/CCN.2018.1133-0.

Under review

1. **Cohen Y**, Nicholson DA, and Gardner TJ (2020) "TweetyNet: A neural network that enables high-throughput, automated annotation of birdsong" *bioRxiv*, doi:10.1101/2020.08.28.272088. (https://www.biorxiv.org/content/10.1101/2020.08.28.272088v1.full.pdf)

2. **Cohen Y**, Schneidman E, Paz R "A geometric representation unveils learning dynamics in primate neurons". *Reviewed and revisions requested, Neuron* (https://www.biorxiv.org/content/10.1101/561670v4.full.pdf)

Papers in preparation

1. **Cohen Y**, Cvitanovic P, Solla SA "A novel approach to the empirical characterization of learning in biological systems".

2. Leman DP, Chen IA, Yen, WW, **Cohen Y**, Perkins, LN, Liberti III WA, Kilic K, Cruz-Martin A, Gardner TJ, Otchy TM, Davison IG. "Large-scale cellular-resolution imaging of neural activity in freely behaving mice."

Honors and Awards

- Dr. Oboh-Weilke Postdoctoral Travel Award 2019
- Nvidia GPU Grant 2017
- Neurizons2013 2nd place poster prize 2013
- Member of the honors program of the faculty of science, *The Hebrew University* 1997-2000

Presentations

Conference Abstracts

- "Calcium imaging and machine learning tools for birdsong annotation reveal stability and neural correlates of canary song syntax" *SFN, Chicago*, 2019
- "Hidden neural states underlie history-dependent canary song sequences", *COSYNE, Lisbon* ,2019
- "A novel approach to the empirical characterization of learning in biological systems" *COSYNE, Lisbon*, 2019
- "Hidden neural states underlie history-dependent canary song sequences" *SFN, San Diego*, 2018
- "A combined convolutional-recurrent deep neural network for accurate annotation of large birdsong datasets" *SFN, San Diego*, 2018
- "Calcium imaging in canary (serinus canaria) HVC reveals latent states supporting behavioral sequencing with long range history dependence", *CCNeuro, Philadelphia*, 2018
- "Neural Networks for Segmentation of Vocalizations" (*Talk*) *PyData, NYC*, 2017
- "Calcium signals of order, syntax, and action in canary (serinus canaria) HVC" *SFN, Washington DC*, 2017
- "Self-splaying silicon carbide electrode assemblies for stable recording and stimulation" *SFN, San Diego*, 2016
- "Learning in a noisy environment: a Lyapunov equation approach" *APS, Baltimore*, 2016
- "Single neuron dynamics in primate striatum and prefrontal cortex during classification learning" *COSYNE, Salt Lake City*, 2016
- "Learning to classify: from behavior to neural dynamics" (*Talk*) *Weizmann Institute of Science*, 2015
- "Learning to classify with high-order features: from behavior to neural correlates" *Neurizons, Göttingen*, 2013
- "Improving individual classification learning using a predictive maximum entropy model" *COSYNE, Salt Lake City*, 2012

Invited Talks

- Technion, Rappaport medical school, Dept. of Neuroscience, December 2019
- Hebrew University, Haddassah medical school, December 2019
- Weizmann Institute, Dept. of Neurobiology, December 2019
- Janelia HHMI, Junior Scientist Workshop on Mechanistic Cognitive Neuroscience, October 2019
- BU, Neurophotonics Symposium, January 2019
- BU, Junior Faculty Meeting, December 2018
- UC Berkeley, invited seminar, December 2018
- Birdsong, SFN satellite meeting November 2018
- NYU, Center for Neural Science April 2015
- Columbia University, Dept. of Biological Sciences April 2015
- Harvard University, Dept. of Physics April 2015
- Boston University, Dept. of Biology April 2015
- UC Berkeley , Dept. of Molecular and Cell Biology April 2015
- UCSD, Dept. of Physics April 2015
- Minna James Heinemann workshop, Weizmann Institute of Science January 2015

Teaching and Mentorship

CAS NE520 spring 2019
Invited lecturer; *Developed and presented a graduate level presentation of research in canaries.*

Neurophotonics bootcamp summer 2019
Lecturer; *Taught basic concepts in photonics to graduate trainees in a lecture and a hands-on lab.*

Daniel Leman 2017–2019
Research Technician; *Developed surgical/optical methods to longitudinally record cells in HVC. Co-author on a manuscript.*

Alexa Sanchioni 2017–present
Undergraduate Researcher; *Worked on audio annotation and, with a UROP award, pioneered analyses of neuronal ensemble activity in stereotyped birdsong.*

Emily Mallaber 2018
Undergraduate Researcher;*Piloted data analysis of behavioral perturbation in canary song sequences.*

Vika Skidanova 2018
Undergraduate Researcher; *Initiated behavior analyses of pharmacological perineural net. digestion in premotor song nuclei.*

Haley Cerratani 2019
Undergraduate Researcher; *Initiated behavior analyses of pharmacological lesions in striatal song nuclei.*

Carlos Gomez 2016–2017
Research Technician; *Developed measurement setups and techniques for SiC electrode QA tests. Contributed to results in 2 peer review publications.*

Community outreach and services

Popular lectures for school children 2018
Overview: My presentations in a local elementary school, "What can we learn from songbirds?" aim to communicate the passion for science and describe some of the questions we have and how songbirds can help us answer them in the lab.

Ad Hoc Referee: *journal of behavioral processes* 2017–present
Ad Hoc Referee: *PLoS Computational Biology* 2020–present

Publicly available software tools

- Deep neural net. for birdsong segmentation and annotation (python) (https://github.com/yardencsGitHub/tweetynet)
- Automated annotation of animal vocalizations (python) (https://github.com/NickleDave/vak)
- GUI for manual sound annotation (Matlab) (https://github.com/yardencsGitHub/BirdSongBout/tree/master/helpers/GUI)