Timothy W. Dunn

Contact Information	twdunn@fas.harvard.edu Phone: (818) 796-3866	Biological Laboratories 1008E 16 Divinity Avenue Cambridge, MA 02138

Current Appointment

Harvard University. College Fellow of Molecular and Cellular Biology. 2016
- Designing and lecturing course on modern computational techniques for biological data analysis (mcb112.org)
- Building brain-wide circuit models for animal behavior

Education

Ph.D. in Neurobiology, **Harvard University** 2015
Brain-wide neural dynamics underlying looming-evoked escapes and spontaneous exploration with Florian Engert

B.A. in Molecular and Cell Biology, **University of California at Berkeley** 2008
With Highest Honors

Honors and Awards

A1 Fellowship (international collaboration). Japan National Institute of Genetics. 2015
National Science Foundation (NSF) Graduate Opportunities Worldwide Fellowship 2013
Harvard University Certificate of Distinction in Teaching
National Science Foundation (NSF) Graduate Research Fellowship 2011
Molecular and Cell Biology Department Citation (Best in Class). UC Berkeley. 2008
I.L. Chaikoff Award for Excellence in Undergraduate Research. UC Berkeley.
Nathan and Violet David Scholarship (competitve research fellowship). UC Berkeley. 2007
Regents and Chancellor's Scholarship (full undergraduate funding). UC Berkeley. 2004

Research Experience

Harvard University. Postdoctoral Researcher *with Florian Engert* 2015 – 2016
- Built circuit models of zebrafish optomotor behavior based on functional imaging data
- Simulated foraging and exploration to probe state-dependent, spontaneous search strategies

Harvard University. Graduate Researcher *with Florian Engert* 2010 – 2015
- Built new software to measure fast animal behaviors with precise environmental control
- Developed new software to assay these behaviors during two-photon imaging of brain activity
- Discovered new principles governing neural population encoding of threatening visual stimuli
- Connected hindbrain nuclei to the statistical generation of spontaneous swimming patterns

While a Visiting Scientist *with Misha Ahrens* at **HHMI Janelia Research Campus**:
- Light-sheet imaged pan-neuronal genetically encoded calcium indicators in behaving animals
- Linked neural activity to behavior using regression-based tools to refine brain-wide data

While an international NSF Graduate Fellow *with Filippo Del Bene* at **Institut Curie**:
- Measured activity in specific populations of inhibitory interneurons in the zebrafish optic tectum

Harvard University. Graduate Researcher *with Bruce Bean* 2009
- Patch-clamped acutely dissociated neurons to assess serotonin type 3 receptor inactivation

University of California, Berkeley. Research Specialist *with Richard Kramer* 2008 – 2009
- Performed cysteine-scanning mutagenesis to identify binding sites for chemical photoswitches

University of California, Berkeley. Undergraduate *with Richard Kramer* 2005 – 2008
- Used electrophysiology and molecular biology to optimize the reactivity of light-switchable ion channel blockers with reactive residues on extracellular domains

Publications

Naumann EA, Fitzgerald JE, Dunn TW, Rihel J, Sompolinsky H, Engert F (**2016**). "From whole-brain data to functional circuit models: the zebrafish optomotor response." *Cell*

Dunn TW*, Mu Y*, Narayan S, Randlett O, Naumann EA, Yang C-T, Schier AF, Freeman J, Engert F, Ahrens MB (**2016**). "Brain-wide mapping of neural activity controlling zebrafish exploratory locomotion." *eLife*

Dunn TW, Gebhardt C, Naumann EA, Riegler C, Ahrens MB, Engert F, Del Bene F (**2016**). "Neural circuits underlying visually evoked escapes in larval zebrafish." *Neuron*

Huang KH, Ahrens MB, Dunn TW, Engert F (**2013**). "Spinal projection neurons control turning behaviors in zebrafish." *Current Biology*

Kokel D, Dunn TW, Ahrens MB, Alshut R, Cheung CY, Saint-Amant L, Bruni G, Mateus R, van Ham TJ, Shiraki T, Fukada Y, Kojima D, Yeh JR, Mikut R, von Lintig J, Engert F, Peterson RT (**2013**). "Identification of nonvisual photomotor response cells in the vertebrate hindbrain." *Journal of Neuroscience*

Fortin DL, Dunn TW, Fedorchak A, Allen D, Montpetit R, Banghart MR, Trauner D, Adelman JP, Kramer RH (**2011**). "Optogenetic photochemical control of designer K+ channels in mammalian neurons." *Journal of Neurophysiology*

Fortin DL, Dunn TW, Kramer RH (**2011**). "Engineering light-regulated ion channels." *Cold Spring Harbor Protocols*

Fortin DL, Banghart MR, Dunn TW, Borges K, Wagenaar DA, Gaudry Q, Karakossian MH, Otis TS, Kristan WB, Trauner D and Kramer RH (**2008**). "Photochemical control of endogenous ion channels and cellular excitability." *Nature Methods*

Talks

"Snell's transformation of images in water." Neurotuscany Circuits and Behavior Conference, 2016, Montecastelli Pisano, Italy

"Methods for analyzing whole-brain data and behavior." Humboldt-Universität, 2016, Berlin, Germany

"Spontaneous brain rhythms and exploration." Cold Spring Harbor Laboratory, 2016, Cold Spring Harbor, NY

"A hindbrain control system for exploratory locomotion." Japan National Institute of Genetics, 2015, Mishima, Japan

"Spontaneous swimming behavior controlled by the hindbrain oscillator." Neurotuscany Circuits and Behavior Conference, 2015, Montecastelli Pisano, Italy

"Neural basis of escapes and spontaneous behavior patterns in larval zebrafish." Harvard Medical School, 2015, Boston, MA

"Neural control of spontaneous behavior patterns in larval zebrafish." Computational and Systems Neuroscience Meeting, 2015, Salt Lake City, UT

"Spontaneous behavior in larval zebrafish." Harvard Medical School Program in Neuroscience Meeting, 2014, Woods Hole, MA

"Looming-evoked escape behavior in larval zebrafish." Shanghai Institute of Neuroscience, 2013, Shanghai, China

"Engineering Photosensitive Potassium Channels." UC Berkeley Neurobiology Undergraduate Research Symposium, 2008, Berkeley, CA

Teaching Experience

Harvard University.

Lecturer. MCB 112: Biological Data Analysis — 2016

Guest Lecturer. OEB 105: Neurobiology of Motor Control — 2015

Teaching Fellow. MCB 105: Systems Neuroscience — 2011, 2012, 2013

Co-Director. Imaging and Behavioral Analysis Workshop — 2013

Japan National Institute of Genetics, Mishima.

Course Instructor. Zebrafish Imaging and Transgenesis — 2015

Massachusetts Institute of Technology.

Perceptron: An interactive video installation visualizing motion perception. (septmay.org) — 2013

Technical Expertise

Analysis

Image analysis, signal analysis, dimensionality reduction, neural network modeling, hidden Markov models, expectation-maximization, maximum likelihood, regression, classification, bootstrapping

Programming Languages/Frameworks

Proficiency in Python, MATLAB, C#, OpenCV

Experience with DirectX, LabVIEW, C, HTML, JavaScript, Julia, Scheme, Processing, OpenRefine

Hardware

Data acquisition, high-speed imaging, instrument control and automation, optics, laser-scanning and light-sheet microscopy, fluorescence, electronics, machining

Other

Interactive visualizations of data and movement, web scraping