

**Talmo Pereira**  
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Ph.D. Candidate in Neuroscience

## RESEARCH

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I'm interested in building computational tools to understand biological problems that would not be tractable otherwise. I like solving problems using computer vision and deep learning, including developing novel approaches to image registration, segmentation, multi-object tracking, pose estimation, timeseries segmentation, few shot, unsupervised and self-supervised learning.

In my PhD, I leveraged behavioral quantification as a handle into how biological neural circuits perform the computations necessary to transform sensory information into motor behaviors in the fruit fly (*Drosophila melanogaster*). I developed hardware for measuring animal motion at high resolution, as well as computational methods for analyzing social behaviors using deep learning and computer vision.

My work has been featured in [Quanta Magazine](#), [Nature Toolbox](#), [Nature Lab Animal](#), [The Scientist](#), [Princeton Insights](#), and more.

## EDUCATION

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2015 - PRESENT	<b>Princeton University</b> , Princeton, NJ Ph.D. in NEUROSCIENCE
2015	<b>Marine Biological Laboratory</b> , Woods Hole, MA BRAINS, MINDS & MACHINES Summer Course
2014	<b>Massachusetts Institute of Technology</b> , Cambridge, MA QUANTITATIVE METHODS IN BIOLOGY Workshop
2011 - 2015	<b>University of Maryland, Baltimore County (UMBC)</b> , Baltimore, MD B.S. in BIOINFORMATICS & COMPUTATIONAL BIOLOGY

## EXPERIENCE

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7/2015 - PRESENT	<b>Princeton Neuroscience Institute</b> <i>Advisors:</i> Mala Murthy and Joshua Shaevitz Using fruit flies ( <i>Drosophila melanogaster</i> ) to study how the brain integrates sensory information to pattern behavioral sequences. Developed hardware and software for acquisition and processing of high resolution video, audio and realtime instrument control. Developed computational methods that leverage computer vision, deep learning, signal processing and unsupervised machine learning for quantifying behavior through few shot pose estimation and manifold embedding. Working on mapping the substrates and function of biological neural circuits involved in patterning the structure of complex motor behaviors.
6/2019 - 12/2019	<b>Google AI</b> <i>Supervisors:</i> Shay Ohayon and Caroline Pantofaru Research internship at Google AI in Machine Perception. Developed deep learning systems for human action recognition.

- 6/2014 - 8/2014 | **California Institute of Technology**  
**Advisor:** David J. Anderson  
 Worked on computational analysis of aggressive behaviors in fruit flies using methods in computer vision for animal tracking and supervised machine learning for timeseries segmentation.
- 6/2013 - 8/2013 |  
 1/2014 - 5/2014 | **Massachusetts Institute of Technology**  
**Advisor:** Sebastian Seung  
 Worked on image processing algorithms for large scale (100-1000s GiB) electron microscopy image alignment/registration for connectomic reconstruction.
- 1/2013 - 6/2015 | **University of Maryland, Baltimore County**  
**Advisor:** Ivan Erill  
 Developed computational algorithm for GPU-accelerated transcription factor DNA binding site prediction in large scale (10-100s GiB) metagenomic sequencing data. to characterize transcriptional regulatory networks.
- 6/2012 - 8/2012 | **Broad Institute of MIT and Harvard**  
 Stanley Center for Psychiatric Research  
**Advisor:** Jon Madison  
 Worked on characterizing interactions between proteins associated with psychiatric disease in the axon initial segment via immunochemical assays.
- 6/2010 - 6/2011 | **National Institutes of Health**  
 National Institute of Dental and Craniofacial Research (NIDCR)  
**Advisor:** Abner L. Notkins  
 Characterized the learning and memory impairment induced by knockout of a type-1 diabetes-associated neuroendocrine transport gene in mice.

## PUBLICATIONS

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1. **Pereira, Talmo D**, J. Li, J. W. Shaevitz, and M. Murthy. Multi-timescale and multi-sensory influences on a social interaction. *In prep*, 2021
2. **Pereira, Talmo D**, J. W. Shaevitz, and M. Murthy. Quantifying behavior to understand the brain. *Nat. Neurosci.*, pages 1-13, Nov. 2020
3. **Pereira, Talmo D**, N. Tabris, J. Li, S. Ravindranath, E. S. Papadoyannis, Z. Yan Wang, D. M. Turner, G. McKenzie-Smith, S. D. Kocher, A. L. Falkner, J. W. Shaevitz, and M. Murthy. SLEAP: Multi-animal pose tracking. *bioRxiv*, page 2020.08.31.276246, Sept. 2020
4. J. M. Jones, W. Foster, C. R. Twomey, J. Burdge, O. M. Ahmed, **Pereira, Talmo D**, J. A. Wojick, G. Corder, J. B. Plotkin, and I. Abdus-Saboor. A machine-vision approach for automated pain measurement at millisecond timescales. *Elife*, 9, Aug. 2020
5. Princeton Open Ventilation Monitor Collaboration, P. Bourrienne, S. Chidzik, D. J. Cohen, P. Elmer, T. Hallowell, T. J. Kilbaugh, D. Lange, A. M. Leifer, D. R. Marlow, P. D. Meyers, E. Normand, J. Nunes, M. Oh, L. Page, **Pereira, Talmo**, J. Pivarski, H. Schreiner, H. A. Stone, D. W. Tank, S. Thiberge, and C. Tully. Inexpensive multi-patient respiratory monitoring system for helmet ventilation during COVID-19 pandemic. *medRxiv*, 2020
6. A. S. Charles, B. Falk, N. Turner, **Pereira, Talmo D**, D. Tward, B. D. Pedigo, J. Chung, R. Burns, S. S. Ghosh, J. M. Kebschull, et al. Toward community-driven big open brain science: Open big data and tools for structure, function, and genetics. *Annual Review of Neuroscience*, 43, 2020
7. D. Deutsch, D. Pacheco, L. Encarnacion-Rivera, **Pereira, Talmo**, R. Fathy, J. Clemens, C. Gi-

- rardin, A. Calhoun, E. Ireland, A. Burke, S. Dorkenwald, C. McKellar, T. Macrina, R. Lu, K. Lee, N. Kemnitz, D. Ih, M. Castro, A. Halageri, C. Jordan, W. Silversmith, J. Wu, H. S. Seung, and M. Murthy. The neural basis for a persistent internal state in drosophila females. *Elife*, 9, Nov. 2020
8. **Pereira, Talmo D\***, Aldarondo, Diego E\*, L. Willmore, M. Kislin, S. S.-H. Wang, M. Murthy, and J. W. Shaevitz. Fast animal pose estimation using deep neural networks. *Nature methods*, 16(1):117, 2019
  9. A. Badura, J. L. Verpeut, J. M. Metzger, **Pereira, Talmo D**, T. J. Pisano, B. Deverett, D. E. Bakshinskaya, and S. S. Wang. Normal cognitive and social development require posterior cerebellar activity. *eLife*, 7:e36401, 2018
  10. J. Clemens, P. Coen, F. A. Roemschied, **Pereira, Talmo D**, D. Mazumder, D. E. Aldarondo, D. A. Pacheco, and M. Murthy. Discovery of a new song mode in drosophila reveals hidden structure in the sensory and neural drivers of behavior. *Current Biology*, 28(15):2400–2412, 2018
  11. G. B. Hermsdorff, **Pereira, Talmo**, and Y. Niv. Quantifying humans’ priors over graphical representations of tasks. In *International Conference on Complex Systems*, pages 281–290. Springer, 2018
  12. A. Giovannucci, E. Pnevmatikakis, B. Deverett, **Pereira, T**, J. Fondriest, M. Brady, S.-H. Wang, W. Abbas, P. Parés, and D. Masip. Automated gesture tracking in head-fixed mice. *Journal of neuroscience methods*, 300:184–195, 2018
  13. **Pereira, Talmo D** and M. Murthy. To fight or not to fight. *Neuron*, 95(5):986–988, 2017
  14. A. Giovannucci, A. Badura, B. Deverett, F. Najafi, **Pereira, Talmo D**, Z. Gao, I. Ozden, A. D. Kloth, E. Pnevmatikakis, L. Paninski, et al. Cerebellar granule cells acquire a widespread predictive feedback signal during motor learning. *Nature neuroscience*, 20(5):727, 2017
  15. Hobbs, Elizabeth T\*, **Pereira, Talmo\***, P. K. O’Neill, and I. Erill. A bayesian inference method for the analysis of transcriptional regulatory networks in metagenomic data. *Algorithms for Molecular Biology*, 11(1):19, 2016

## PRESENTATIONS

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| 2020 | <p><b>Massachusetts Institute of Technology</b><br/>         Cambridge, MA<br/>         COMPUTATIONAL TUTORIAL: Decoding Animal Behavior Through Pose Tracking</p>                           |
| 2020 | <p><b>American Physical Society March Meeting</b><br/>         Denver, CO<br/>         TALK: Multi-animal pose tracking using deep neural networks</p>                                       |
| 2020 | <p><b>Computational and Systems Neuroscience (Cosyne)</b><br/>         Denver, CO<br/>         POSTER: Multi-animal pose tracking and predictive modeling of social interactions</p>         |
| 2019 | <p><b>Junior Scientist Workshop on Machine Learning and Computer Vision</b><br/>         Janelia Farm, Ashburn, VA<br/>         TALK: Few shot multi-animal pose estimation and tracking</p> |
| 2019 | <p><b>Annual BRAIN Initiative Investigators Meeting</b><br/>         Washington, DC<br/>         POSTER: Few shot multi-animal pose estimation and tracking</p>                              |

- 2018 | **Society for Neuroscience Conference**  
San Diego, CA  
POSTER: Fast estimation of animal pose using deep neural networks
- 2018 | **Princeton Neuroscience Institute Departmental Retreat**  
Avalon, NJ  
TALK: Fast, automated pose estimation in freely moving animals
- 2017 | **Princeton Bioengineering Colloquium**  
Princeton, NJ  
TALK: Understanding acoustic communication through unsupervised behavioral quantification
- 2017 | **Computational and Systems Neuroscience (Cosyne)**  
Salt Lake City, UT  
WORKSHOP CO-ORGANIZER: Automated Tools for High Dimensional Neuro-Behavioral Analysis
- 2016 | **Action Selection Across the Animal Kingdom Conference**  
Janelia Farm, Ashburn, VA  
POSTER: Quantifying fly courtship to discover principles for action selection
- 2016 | **Society for Neuroscience Conference**  
San Diego, CA  
POSTER: High dimensional neuroanatomical and behavioral analysis for probing cerebellar involvement in nonmotor function

## SCHOLARSHIPS & AWARDS

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- 2019 | **Porter Ogden Jacobus Fellowship**  
Top honor for PhD students at Princeton University.
- 2019 | **Princeton Intellectual Property Accelerator Fund**  
Awarded \$100,000 to develop AI framework for animal pose estimation.
- 2015 | **Princeton University President's Prize**  
Awarded honorific fellowship on admission to graduate program.
- 2015 | **NSF Graduate Research Fellowship Program**  
One of 2,000 awardees selected from a pool of 16,500 applicants for the grant.
- 2014 | **The Barry Goldwater Scholarship and Excellence in Education Program**  
Received an Honorable Mention from a pool of 1,166 nationwide nominees.
- 2013 | **MARC Undergraduate Student Training in Academic Research**  
The MARC U-STAR scholarship is an award funded by the NIH in an effort to support undergraduates in pursuing experiences and a career in research. Provides a research stipend, full academic scholarship, funding for lab expenses and travel.
- 2012 | **UMBC Undergraduate Research Award (URA)**  
Research grant awarded to undergraduates pursuing research on campus.

- 2012 | **Howard Hughes Medical Institute Scholar**  
Highly selective HHMI-sponsored program aiming to increase diversity in the biomedical sciences. Supports students with a research stipend, pre-professional advising and funding for summer research.
- 2011 | **Meyerhoff Scholar**  
Selective scholarship program at UMBC supporting underrepresented minorities pursuing a career in research in the STEM fields.
- 2011 | **Broad Prize Scholar**  
Broad Prize scholarships are awarded to graduating seniors who have a demonstrated record of improving their grades over the course of their high school career and have a financial need by the Eli and Edythe Broad Foundation. One of thirteen awardees in Montgomery County, MD.

## TEACHING

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- 2018 |  
2017 | **Course Instructor: Intro to Scientific Programming**  
Designed and taught an undergraduate summer course in computational methods in neuroscience at Princeton University.
- 2017 | **Teaching Assistant: NEU 457 - Measurement and Analysis of Neural Circuit Dynamics**  
**Professors:** David Tank and Andrew Leifer  
Designed problem sets, lectured and graded senior/graduate level methods course in computational analysis of neural data at Princeton University.
- 2016 | **Teaching Assistant: NEU 201 - Fundamentals of Neuroscience**  
**Professor:** Ilana Witten  
Led discussion/recitation sections for undergraduate introductory neuroscience at Princeton University.
- 2014 | **Course Instructor: Intro to Computer Programming for Biologists**  
Designed and taught a graduate-level winter course in computational methods in biology at MIT.
- 2013 | **Teaching Assistant: Introductory Biology**  
Served as undergraduate teaching assistant for discussion component of the introductory Biology class. Held weekly graded sessions for a class of 34 students.
- 2012 | **Supplemental Instruction Leader: Introductory Biology**  
Held two weekly sessions of guided study for the introductory Biology class promoting collaborative learning in contrast to passive lecture-based instruction.

## SERVICE & MENTORSHIP

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**Student mentorship:** Served as the research mentor to 15 undergraduate and high school students (summer to multiple semesters).

**Peer review:** Invited to review manuscripts for publication at *Nature Methods*, *eLife*, *Neuroinformatics*, *Scientific Reports*, *Neuron*, & others.

- 2016-2021 | **Princeton Neuroscience Institute Graduate Recruitment**  
Served on panels, gave talks, organized and hosted lab tours, provided one-on-one mentorship before the application and interview to prospective students applying to the Princeton Neuroscience Institute PhD program.

- 2018 | **SACNAS**  
Recruited URMs at the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science Conference in with the Princeton Diversity and Inclusion team.
- 2017 | **Princeton Diversity Hosting Weekend**  
Hosted accepted URM graduate students, guided tours and served on panel.
- 2016 | **ABRCMS**  
Recruited URMs at the Annual Biomedical Research Conference for Minority Students with the Princeton Diversity and Inclusion team.