

# Benjamin J. Matthews, Ph.D.

telephone: 1-718-679-6097

email: ben.matthews@zoology.ubc.ca

web: <http://bnmtthws.github.io>

Assistant Professor  
Department of Zoology  
University of British Columbia  
Vancouver, BC V6T 1Z4 Canada

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## EMPLOYMENT

**Assistant Professor**, as of September 2019

Department of Zoology, Comparative Physiology Group  
University of British Columbia, Vancouver, BC Canada

## EDUCATION AND TRAINING

**Postdoctoral Scientist**, 2010-2019. **Jane Coffin Childs Fellowship**, 2011-2014

Rockefeller University and Howard Hughes Medical Institute, New York, NY  
Advisor: Leslie B. Vosshall, Laboratory of Neurogenetics and Behavior

**Ph.D. with distinction in Neurobiology and Behavior**, 2005-2010

Columbia University, New York, NY. Degree conferred Oct. 20, 2010  
Advisor: Wesley B. Grueber, Departments of Physiology and Neuroscience

**B.S., Biology**, 2000-2004

California Institute of Technology, Pasadena, CA. Degree conferred June 11, 2004.

## RESEARCH EXPERIENCE

**Laboratory Head, Department of Zoology, UBC** As of September 2019.

The mosquito *Aedes aegypti* is a global, deadly vector of arboviral pathogens that cause Zika, Dengue fever, yellow fever, and Chikungunya. Our laboratory is broadly interested in how the genome of the mosquito encodes the capacity for adaptive behaviors such as blood-feeding on human hosts and identifying appropriate aquatic egg-laying sites. We draw on techniques from genome-editing, genomics, and neuroscience to dissect the genetic and neural circuit basis of mosquito behavior and coordinate changes in physiology that underly these deadly adaptations.

**Postdoctoral Research, Laboratory of Neurogenetics and Behavior. Leslie Vosshall, PI Rockefeller University and HHMI.** September 2010 to present.

As part of my postdoctoral work, I transformed *Aedes aegypti* into a tractable molecular genetic study system. I led a consortium to generate a chromosome-scale genome assembly and geneset annotation of *Ae. aegypti*. I broadly profiling gene expression in brain and sensory tissues of mosquitoes to identify candidate genes involved in numerous aspects of mosquito behavior and biology and developed CRISPR/Cas9 gene editing protocols for efficiently and flexibly generating knockouts and knockins. I combined these tools and resources to generate mutations in candidate sensory receptors and developed genetic approaches to label, visualize, and manipulate molecularly-identified cell types in the mosquito nervous system, ultimately identifying an ion channel, *ppk301*, as a key regulator of egg-laying and egg-laying preference

**PhD Research, Columbia University, Doctoral Program in Neurobiology and Behavior.**

January 2006 to September 2010, Ph.D. advisor: Wesley B. Grueber

Self-avoidance is a fundamental rule seen across many dendritic and axonal arbors as individual neurites within an arbor spread from one another while ignoring neurites from neighboring cells. During my PhD, I detailed the molecular principles underlying self-avoidance through genetic studies of *Drosophila melanogaster Dscam1*. Alternative splicing can produce *Dscam1* isoforms with >19,000 distinct ectodomains and stochastic splicing of *Dscam1* endows cells with unique cell surface identities that mediate selective binding leading to axon or dendrite repulsion. I demonstrated that removing *Dscam1* from sensory neurons with complex dendritic arbors caused arbors to collapse and that forcing two neurons with normally overlapping arbors to share isoforms caused inappropriate recognition as 'self' and aberrantly partitioned territories.

**Research Assistant, University of California, Irvine.** July 2004 to August 2005

Laboratory of Susana Cohen-Cory. BDNF regulation of synaptogenesis and dendritogenesis.

**Undergraduate Research, Caltech.** September 2003 to July 2004. Laboratory of John Allman.

Functional imaging of the human brain in response to humorous art and language.

## **PUBLICATIONS**

**Matthews B.J.\***, Younger M.A.\*, and Vosshall L.B. The ion channel *ppk301* controls freshwater egg-laying in the mosquito *Aedes aegypti*. eLife (2019) 8:e43963 bioRxiv (2018)  
(\* denotes equal contribution)

**Matthews B.J.\***, Dudchenko O.\*, Kingan, S.\*, (et al., 68 middle authors) and Vosshall, L.B. Improved reference genome of *Aedes aegypti* informs arbovirus vector control. Nature (2018) 563:501-507. bioRxiv (2017) (\* denotes equal contribution)

Trible W., Olivos-Cisneros L., McKenzie S.K., Saragosti J., Chang, N.C., **Matthews B.J.**, Oxley P.R., and Kronauer, D.J.C. *orco* mutagenesis causes loss of antennal lobe glomeruli and impaired social behavior in ants. Cell (2017) 170: 727-735.e10. bioRxiv (2017)

**Matthews B.J.**, McBride C.S., DeGennaro, M., Despo O. and Vosshall, L.B. The neurotranscriptome of the *Aedes aegypti* mosquito. BMC Genomics (2016) 17:32. bioRxiv (2015)

Kistler K.E., Vosshall L.B., and **Matthews B.J.** Genome-engineering with CRISPR-Cas9 in the mosquito *Aedes aegypti*. Cell Reports (2015) 11:51-60. bioRxiv (2014)

McMeniman C.J., Corfas R.A., **Matthews B.J.**, Ritchie S.A., Vosshall L.B. Multimodal integration of carbon dioxide and other sensory cues drives mosquito attraction to humans. Cell (2014) 156:1060-1071

**Matthews B.J.** and Grueber W.B. Dscam1-mediated self-avoidance counters Netrin-dependent targeting of dendrites in *Drosophila*. Current Biology (2011) 21:1480-1487

Hattori, D., Chen, Y., **Matthews, B.J.**, Salwinski, L., Sabatti, C., Grueber, W.B., and Zipursky S.L. Robust discrimination between self and non-self neurites requires thousands of Dscam1 isoforms. Nature (2009) 461:644-648

**Matthews B.J.**, Kim, M.E., Flanagan, J.J., Hattori, D., Clemens, J.C., Zipursky S.L., and Grueber, W.B. Dendrite self-avoidance is controlled by Dscam. Cell (2007) 129: 593-604

Watson, K. K., **Matthews, B. J.**, and Allman, J. M. Brain activation during sight gags and language-dependent humor. Cerebral Cortex (2007) 17:314-324

Sanchez, A. L. \*, **Matthews, B. J.\***, Meynard, M. M. \*, Hu, B. \*, Javed, S., and Cohen-Cory, S. C. BDNF increases synapse density in dendrites of developing tectal neurons in vivo. Development (2006) 133:2477-2486 (\* denotes equal contribution)

## **INVITED REVIEWS**

**Matthews B.J.** *Aedes aegypti*. Trends in Genetics (2019) 35(6):470-471

Corty, M.M.\*, **Matthews B.J.\***, and Grueber W.B. Molecules and mechanisms of dendrite development in *Drosophila*. Development (2009) 136:1049-1061 (\* denotes equal contribution)

**Matthews B.J.**, Corty M.M., and Grueber W.B. Of cartridges and columns: new roles for cadherins in visual system development. Neuron (2008) 58:1-3

## **FUNDING AND AWARDS**

- Jane Coffin Childs Memorial Fund for Medical Research, HHMI Fellow (2011-2014): “Molecular genetics of water sensation and oviposition site preference in the yellow fever mosquito”
- Henry and Marie-Josée Kravis Postdoctoral Fellow, Rockefeller University (2010-2011): “Molecular genetics of oviposition site preference in the yellow fever mosquito”
- NIH/NINDS Ruth L. Kirschstein F31 Individual NRSA Predoctoral Fellowship (2007-2010): “Dscam diversity and circuit formation in the *Drosophila* nervous system.”
- Kavli Award for Distinguished Research in Neuroscience, Columbia University (2010)  
Awarded each year to the best PhD dissertation in neuroscience at Columbia University

## **SELECTED ORAL PRESENTATIONS**

- Plant and Animal Genomes, San Diego, CA (2019)
- Department of Zoology, University of British Columbia, Vancouver, BC, Canada (2019)
- Neuroscience Institute, New York University, New York, NY (2019)
- School of Biological Sciences, University of Utah, Salt Lake City, UT (2018)
- Department of Entomology, Cornell University, Ithaca, NY (2018)
- SMRT Scientific Symposium Leiden, Netherlands (2018) Keynote Speaker
- Department of Biology, University of Pennsylvania, Philadelphia, PA (2018)
- “Rockefeller’s Talking Science: The World’s Most Dangerous Animal,” New York, NY (2018)
- Bioethical Issues Committee Symposium series, NYC Bar Association, New York, NY (2017)
- Plant and Animal Genomes, San Diego, CA (2017)
- International Congress of Entomology, Orlando, FL (2016)
- Rockefeller University Summer Science Research Program, New York, NY (2016)
- World Science Festival, New York, NY (2016)
- International Behavioural and Neural Genetics Society, Uppsala, Sweden (2015)
- New Jersey Mosquito Control Association Annual Meeting, Atlantic City, NJ (2015)
- Memorial Sloan Kettering Cancer Center, “The Genome Editing Revolution,” NY, NY (2014)
- HHMI-Janelia Farm Research Conference “High Throughput Sequencing for Neuroscience,” Ashburn, VA (2014)
- Montclair University “Partners of the Americas,” Montclair, NJ (2014)
- FASEB Science Research Conference: Genome Engineering, Nassau, Bahamas (2014)
- Jane Coffin Childs Memorial Fund 2014 Fellows’ Symposium, Lakeville, CT (2014)
- American Society of Tropical Medicine and Hygiene, Annual Meeting, Washington DC (2013)

## **DIRECT MENTORSHIP**

PhD, MD/PhD Rotation Students: Stephanie Marcus, Margaret Herre\*, Krithika Venkataraman, Joshua Zeng, Molly Liu, Emily Dennis

Research Assistants: Zachary Gilbert, Kathryn Kistler\*

Undergraduate Students: Julia Canick, Eva Shrestha, Nicholas Schwartz

High School Students: Solomon Dworkin, Russell Shephard, Orion Despo\*

\* indicates co-authored publications resulting from mentored projects

## **TEACHING AND COURSE DEVELOPMENT**

- Guest Lecturer New York University, New York, NY. November 2014-2018  
Guest lectures on genome engineering, mosquito behavior, and other topics to advanced undergraduate students as part of “302.002: Neurogenetics and Behavior”
- Technical Workshop on Insect Genetic Modification, University of Maryland. 2017 and 2018  
Planned and taught a module on practical and theoretical considerations of CRISPR-based gene-editing, attended by 20-25 trainees ranging from Technicians to Professors.
- 5<sup>th</sup> TRenD/ISN School on Insect Neuroscience and *Drosophila* Neurogenetics  
Dar es Salaam, Tanzania. September 2015  
Planned and taught a module on insect olfaction and genome engineering as part of an intensive lecture and laboratory-based course for 15 students from African institutions.
- Visiting Assistant Professor, Bard College, Annandale-on-Hudson, NY. Spring 2013  
Proposed, planned, and taught an advanced undergraduate seminar on Genetics, Neuroscience, and Behavior as part of the Bard-Rockefeller Semester in Science.

## **SERVICE**

*Ad hoc* reviewer for:

Applied Sciences, Developmental Biology, eNeuro, G3, Insect Science, Molecular Ecology, PLoS Computational Biology, PLoS Neglected Tropical Diseases, Scientific Reports, Wellcome Trust