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Education

- Ph.D. in Biophysics, thesis with Howard Berg, Harvard University 1999
- B.A. in Physics, Harvard University 1993

Research Appointments

- Professor of Physics, Harvard University 2010-present
- Visiting Scientist, Janelia Research Campus/HHMI 2011-present
- Professor of Physics, Harvard University 2010-present
- Student, Neurobiology of Drosophila course at Cold Spring Harbor Laboratories 2009
- Assistant Professor of Physics, Harvard University 2003-2007
- Postdoctoral Fellow, Harvard University and CSHL 1999-2002
- Student, C. elegans course at Cold Spring Harbor Laboratories 1999
- Student, Neurobiology course at the Marine Biological Laboratories, 1999

Academic Honors

- NSF BRAIN Initiative EAGER Award 2014
- Harvard/MIT Research Grants Program in Basic Neuroscience 2010
- NIH Directors Pioneer Award 2008
- Dana Foundation Award in Brain and Immuno-Imaging 2007
- Presidential Early Career Award for Scientists and Engineers 2006
- NSF CAREER Award 2005
- Alfred P. Sloan Foundation Research Fellow 2004
- Amgen Fellow of the Life Sciences Research Foundation 2000

Publications

[1] J. D. Hawk, A. C. Calvo, A. Almoril-Porras, A. Aljobeh, M. L. Torruella-Suarez, I. Ren, N. Cook, J. Greenwood, L. Luo, A. D. T. Samuel, and D. Colon-Ramos, "Integration of plasticity mechanisms within a single sensory neuron of c. elegans actuates a memory," *bioRxiv*, 2017. [Online]. Available: https://www.biorxiv.org/content/early/2017/06/30/157958

[2] M. Klein, S. V. Krivov, A. Ferrer, L. Luo, A. D. T. Samuel, and M. Karplus, "Exploratory search during directed navigation in c. elegans and drosophila larva," *eLife*, vol. 6, 2017. [Online]. Available: https://elifesciences.org/articles/30503

[3] M. A. Lim, J. Chitturi, V. Laskova, J. Meng, D. Findeis, A. Wiekenberg, B. Mulcahy, L. Luo, Y. Li, Y. Lu, W. Hung, Y. Qu, C.-Y. Ho, D. Holmyard, N. Ji, R. McWhirter, A. D. T. Samuel, D. M. Miller, R. Schnabel, J. A. Calarco, and M. Zhen, "Neuroendocrine modulation sustains the c. elegans forward motor state," *eLIFE*, 18 Nov, 2016 2016. [Online]. Available: https://elifesciences.org/content/5/e19887

[4] Z. A. Knecht, A. F. Silberling, L. Ni, M. Klein, G. Budelli, R. Bell, L. Abuin, A. J. Ferrer, A. D. T. Samuel, R. Benton, and P. A. Garrity, "Distinct combinations of variant ionotropic glutamate receptors mediate thermosensation and hygrosensation in drosophila," *eLife*, 2016. [Online]. Available: http://biorxiv.org/content/early/2016/05/31/056267.full.pdf+html

[5] Y. Shen, Q. Wen, H. Liu, C. Zhong, Y. Qin, G. Harris, T. Kawano, M. Wu, T. Xu, A. Samuel, and Y. Zhang, "An extrasynaptic gabaergic signal modulates a pattern of forward movement in caenorhabditis elegans," *eLife*, vol. 5, p. e14197, 2016. [Online]. Available: http://dx.doi.org/10.7554/eLife.14197

[6] L. van Giesen, L. Hernandez-Nunez, S. Delasoie-Baranek, M. Colombo, P. Renaud, R. Bruggmann, R. Benton, A. D. T. Samuel, and S. Sprecher, "Multimodal stimulus coding by a gustatory sensory neuron in drosophila larvae," *Nature Communications*, vol. 7, p. 10687, 2016.

[7] A. Narayan, V. Venkatachalam, O. Durak, D. K. Reilly, N. Bose, F. Schroeder, A. Samuel, J. Srinivasan, and P. Sternberg, "Contrasting responses within a single neuron class enable sex- specific attraction in c. elegans," *Proceedings of the National Academy of Sciences USA*, 2016.

[8] L. Ni, M. Klein, K. Svec, G. Budelli, E. Chang, R. Benton, A. D. T. Samuel, and P. Garrity, "The ionotropic receptors ir21a and ir25a mediate cool sensing in drosophila," *eLife*, vol. 5, p. e13254, 2016. [Online]. Available: http://dx.doi.org/10.7554/eLife.13254

[9] M. Berck, A. Khandelwal, L. Claus, L. Hernandez-Nunez, G. Si, C. Tabone, F. Li, J. Truman, R. Fetter, M. Louis, A. Samuel, and A. Cardona, "The wiring diagram of a glomerular olfactory system," *eLife*, vol. 5, p. e14859, 2016. [Online]. Available: https://elifesciences.org/content/5/e14859

[10] V. Venkatachalam, N. Ji, X. Wang, C. Clark, J. Mitchell, M. Klein, C. Tabone, J. Florman, H. Ji, J. Greenwood, A. Chisholm, J. Srinivasan, M. Alkema, M. Zhen, and A. Samuel, "Panneuronal imaging in roaming c. elegans," *Proceedings of the National Academy of Sciences USA*, vol. 113, pp. E1082–1088, 2016. [Online]. Available: http://www.pnas.org/content/early/2015/12/23/1507109113.abstract

[11] J. S. Kain, S. Zhang, M. Klein, A. Samuel, and B. de Bivort, "Bet-hedging, seasons and the evolution of behavioral diversity in drosophila," *Evolution*, vol. 69, pp. 3171–3186, 2015. [Online]. Available: http://biorxiv.org/content/biorxiv/early/2014/11/30/012021.full.pdf

[12] M. Zhen and A. D. T. Samuel, "C. elegans locomotion: small circuits, complex functions," *Current Opinion in Neurobiology*, vol. 33, no. 117, p. 126, 2015. [Online]. Available: http://dx.doi.org/10.1016/j.conb.2015.03.009

[13] L. Hernandez-Nunez, J. Belina, M. Klein, G. Si, L. Claus, J. R. Carlson, and A. D. T. Samuel, "Reverse-correlation analysis of navigation dynamics in drosophila larva using optogenetics," *eLife*, vol. 4, p. 9, 2015 2015. [Online]. Available: http://dx.doi.org/10.7554/eLife.06225

[14] M. Klein, B. Afonso, A. J. Vonner, L. Hernandez-Nunez, M. E. Berck, C. J. Tabone, E. A. Kane, V. A. Pieribone, M. N. Nitabach, A. Cardona, M. Zlatic, S. G. Sprecher, M. Gershow, P. A. Garrity, and A. D. T. Samuel, "Sensory determinants of behavioral dynamics in drosophila thermotaxis," *Proceedings of the National Academy of Sciences USA*, vol. 112, no. 2, pp. E220–229, 2015. [Online]. Available: http://www.pnas.org/content/112/2/E220

[15] L. Luo, Q. Wen, J. Ren, M. Hendricks, M. Gershow, Y. Qin, J. Greenwood, E. Soucy, M. Klein, H. Smith-Parker, A. Calvo, D. Colon-Ramos, A. Samuel, and Y. Zhang, "Dynamic encoding of perception, memory and movement in a c. elegans chemotaxis circuit," *Neuron*, vol. 82, pp. 1115–1128, 2014.

[16] L. Luo, N. Cook, V. Venkatachalam, L. Martinez-Velazquez, X. Zhang, A. Calvo, J. Hawk, B. MacInnis, M. Frank, J. H. R. Ng, M. Klein, M. Gershow, M. Hammarlund, M. Goodman, D. Colon-Ramos, Y. Zhang, and A. D. T. Samuel, "Bidirectional thermotaxis in caenorhabditis elegans is mediated by distinct sensorimotor strategies driven by the afd thermosensory neurons," *Proceedings of the National Academy of Sciences USA*, vol. 111, pp. 2776–2781, 2014.

[17] E. A. Kane, M. Gershow, B. Afonso, I. Larderet, M. Klein, A. R. Carter, B. L. de Bivort, S. G. Sprecher, and A. D. T. Samuel, "Sensorimotor structure of drosophila larva phototaxis," *Proceedings of the National Academy of Sciences*, vol. 110, pp. E3868–77, 2013.

[18] D. C. Williams, R. E. Bejjani, P. M. Ramirez, S. Coakley, S. A. Kim, H. Lee, Q. Wen, A. D. T. Samuel, H. Lu, M. A. Hilliard, and M. Hammarlund, "Rapid and permanent neuronal inactivation in vivo via subcellular generation of reactive oxygen with the use of killerred," *Cell Reports*, vol. 5, pp. 553–563, 2013.

[19] A. Reina, A. B. Subramaniam, A. Laromaine, A. D. Samuel, and G. M. Whitesides, "Shifts in the distribution of mass densities is a signature of caloric restriction in caenorhabditis elegans," *PLoS ONE*, vol. 8, p. e69651, 2013.

[20] H. K. Smith, L. Luo, D. O'Halloran, D. Guo, X.-Y. Huang, A. D. Samuel, and O. Hobert, "Defining specificity determinants of cyclic gmp-mediated gustatory sensory transduction in caenorhabditis elegans," *Genetics*, vol. 194, pp. 885–901, 2013.

[21] D. Mathew, C. Martelli, E. Kelley-Swift, C. Brusalis, M. Gershow, A. Samuel, T. Emonet, and J. Carlson, "Functional diversity among sensory receptors in a drosophila olfactory circuit," *Proceedings of the National Academy of Sciences USA*, vol. 110, pp. E2134–43, 2013.

[22] J. Donnelly, C. Clark, A. Leifer, J. Pirri, M. Haburcak, M. Francis, A. Samuel, and M. Alkema, "Monoaminergic orchestration of motor programs in a complex c. elegans behavior," *PLoS Biology*, vol. 11, no. 4, p. e1001529, 2013.

[23] C. Fang-Yen, C. Gabel, A. D. Samuel, C. Bargmann, and L. Avery, *Laser Microsurgery in Caenorhabditis elegans*, 2012, pp. 177–206.

[24] B. Pinan-Lucarre, C. Gabel, S. E. Hulme, S. Shevkopylas, R. Slone, J. Xue, S. Weisberg, G. Whitesides, A. D. Samuel, and M. Driscoll, "The core apoptotic executioner proteins ced-3 and ced-4 promote neuronal regeneration in caenorhabditis elegans," *PLoS Biology*, vol. 10, p. e1001331, 2012. [Online]. Available: http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1001331

[25] D. Omura, D. Clark, A. D. Samuel, and H. Horvitz, "Dopamine signaling sets and maintains a precise rate of locomotion by c. elegans," *PLoS ONE*, vol. 7, p. e38649, 2012.

[26] A. Stavoe, J. Nelson, L. Martinez-Velazquez, M. Klein, A. D. Samuel, and D. Colon-Ramos, "Synaptic vesicle clustering and axon arborization require distinct mig-10/lamellipodin isoforms downstream of netrin," *Genes and Development*, vol. 26, no. 19, pp. 2206–2221, 2012.

[27] Q. Wen, M. Po, E. Hulme, S. Chen, X. Liu, S. Kwok, M. Gershow, A. Leifer, V. Butler, C. Fang-Yen, T. Kawano, W. Schafer, G. Whitesides, M. Wyart, D. Chklovskii, M. Zhen, and A. D. Samuel, "Proprioceptive coupling within motor neurons drives c. elegans forward locomotion," *Neuron*, vol. 76, no. 4, pp. 750–761, 2012. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S0896627312008057

[28] M. Gershow, M. Berck, D. Mathew, L. Luo, E. Kane, J. Carlson, and A. D. Samuel, "Controlling airborne cues during small animal navigation," *Nature Methods*, vol. 9, no. 3, pp. 290–296, 2012. [Online]. Available: http://www.nature.com/nmeth/journal/v9/n3/full/nmeth.1853.html

[29] A. Leifer, C. Fang-Yen, M. Gershow, M. Alkema, and A. D. Samuel, "Optogenetic control with high spatial and temporal resolution in freely moving c. elegans," *Nature Methods*, vol. 8, pp. 147–152, 2011. [Online]. Available: http://www.nature.com/nmeth/journal/v8/n2/abs/nmeth.1554.html

[30] S. Lahiri, K. Shen, M. Klein, A. Tang, E. Kane, M. Gershow, P. Garrity, and A. D. Samuel, "Two alternating motor programs drive navigational decision-making in drosophila larva," *PLoS ONE*, vol. 6, no. 8, p. e23180, 2011. [Online]. Available: http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0023180

[31] P. Garrity, M. Goodman, A. D. Samuel, and P. Sengupta, "Running hot and cold: behavioral strategies, neural circuits, and the molecular machinery for thermotaxis in c. elegans and drosophila," *Genes and Development*, vol. 24, pp. 2365–2382, 2010.

[32] H. Ha, M. Hendricks, Y. Shen, C. Gabel, C. Fang-Yen, Y. Qin, D. Colon-Ramos, K. Shen, A. D. Samuel, and Y. Zhang, "Functional organization of a neural network for aversive olfactory learning in caenorhabditis elegans," *Neuron*, vol. 68, pp. 1173–1186, 2010.

[33] C. Fang-Yen, M. Wyart, J. Xie, R. Kawai, T. Kodger, S. Chen, Q. Wen, and A. D. Samuel, "Biomechanical analysis of gait adaptation in the nematode caenorhabditis elegans," *Proceedings of the National Academy of Sciences USA*, vol. 107, no. 47, pp. 20 323–20 328, 2010.

[34] L. Luo, M. Gershow, M. Rosenzweig, K. Kang, C. Fang-Yen, P. Garrity, and A. D. Samuel, "Navigational decision-making in drosophila thermotaxis," *Journal of Neuroscience*, vol. 30, pp. 4261–4272, 2010.

[35] J. Peidle, C. Stokes, R. Hart, M. Franklin, R. Newburgh, J. Pahk, W. Rueckner, and A. D. Samuel, "Inexpensive microscopy for introductory laboratory courses," *American Journal of Physics*, vol. 77, no. 10, pp. 931–938, 2009.

[36] P. Sengupta and A. D. Samuel, "Caenorhabditis elegans: a model system for systems neuroscience," *Current Opinion in Neurobiology*, vol. 19, pp. 1–7, 2009.

[37] C. Fang-Yen, L. Avery, and A. D. Samuel, "Two size-selective mechanisms specifically trap bacteria-sized food particles in caenorhabditis elegans," *Proceedings of the National Academy of Sciences USA*, vol. 106, no. 47, pp. 20 093–20 096, 2009.

[38] C. Gabel, F. Antoine, C. Chuang, A. D. Samuel, and C. Chang, "Distinct cellular and molecular mechanisms mediate initial axon development and adult-stage axon regeneration in c. elegans," *Development*, vol. 135, pp. 1129–1136, 2008.

[39] L. Luo, C. Gabel, H. Ha, Y. Zhang, and A. Samuel, "Olfactory behavior of swimming c. elegans analyzed by measuring motile responses to temporal variations of odorants," *Journal of Neurophysiology*, vol. 99, no. 5, pp. 2617–2625, 2008.

[40] S. Hulme, S. Shevkopylas, and A. Samuel, "Microfluidics: streamlining discovery in worm biology," *Nature Methods*, vol. 5, no. 7, pp. 589–590, 2008.

[41] D. Biron, S. Wasserman, J. Thomas, A. D. Samuel, and P. Sengupta, "An olfactory neuron responds stochastically to temperature and modulates caenorhabditis elegans thermotactic behavior," *Proceedings of the National Academy of Sciences USA*, vol. 105, no. 31, pp. 11 002–11 007, 2008.

[42] D. Clark, C. Gabel, H. Gabel, and A. D. Samuel, "Temporal activity patterns in thermosensory neurons of freely moving caenorhabditis elegans encode spatial thermal gradients," *Journal of Neuroscience*, vol. 27, no. 23, p. 6083– 6090, 2007.

[43] J. Korta, D. Clark, C. Gabel, L. Mahadevan, and A. D. Samuel, "Mechanosensation and mechanical load modulate the locomotory gait of swimming c. elegans," *Journal of Experimental Biology*, vol. 210, no. 13, pp. 2383–2389, 2007.

[44] C. Gabel, H. Gabel, D. Pavlichin, A. Kao, D. Clark, and A. Samuel, "Neural circuits mediate electrosensory behavior in caenorhabditis elegans," *Journal of Neuroscience*, vol. 27, no. 28, p. 7586 –7596, 2007.

[45] C. Chi, D. Clark, S. Lee, D. Biron, L. Luo, C. Gabel, J. Brown, P. Sengupta, and A. D. Samuel, "Temperature and food mediate long-term thermotactic behavioral plasticity by association-independent mechanisms in c. elegans," *Journal of Experimental Biology*, vol. 210, pp. 4043–4052, 2007.

[46] S. Chung, D. Clark, C. Gabel, E. Mazur, and A. Samuel, "The role of the afd neuron in c. elegans thermotaxis analyzed using femtosecond laser ablation," *BMC Neuroscience*, vol. 7, p. 30, 2006.

[47] D. Clark, D. Biron, P. Sengupta, and A. Samuel, "The afd sensory neurons encode multiple functions underlying thermotactic behavior in caenorhabditis elegans," *Journal of Neuroscience*, vol. 26, no. 28, pp. 7444–7451, 2006.

[48] D. Biron, M. Shibuya, C. Gabel, S. Wasserman, D. Clark, A. Brown, P. Sengupta, and A. Samuel, "A diacylglycerol kinase modulates long-term thermotactic behavioral plasticity in c. elegans," *Nature Neuroscience*, vol. 9, no. 12, pp. 1499–1505, 2006.

[49] L. Luo, D. Clark, D. Biron, L. Mahadevan, and A. Samuel, "Sensorimotor control during isothermal tracking in caenorhabditis elegans," *Journal of Experimental Biology*, vol. 209, pp. 4652–4662, 2006.

[50] D. Clark, C. Gabel, T. Lee, and A. Samuel, "Short-term adaptation and temporal processing in the cryophilic response of caenorhabditis elegans," *Journal of Neurophysiology*, vol. 97, pp. 1903–1910, 2006.

[51] A. Samuel and P. Sengupta, "Sensorimotor integration: locating locomotion in neural circuits," *Current Biology*, vol. 15, no. 9, pp. R341–343, 2005.

[52] M. Colosimo, A. Brown, S. Mukhopadhyay, C. Gabel, A. Lanjuin, A. Samuel, and P. Sengupta, "Identification of thermosensory and olfactory neuron-specific genes via expression profiling of single neuron types," *Current Biology*, vol. 14, pp. 2245–2251, 2004.