

CURRICULUM VITAE
Samuel Sheng-Hung Wang, Ph.D.

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Research interests

- 1) Neuroscience of sensory learning, development, and autism
- 2) Data science for neuroscience, public policy, and election law

Education

1986 B.S. with honor, Physics, California Institute of Technology
1994 Ph.D., Neurosciences, Stanford University (advisor: Stuart H. Thompson)

Professional positions

1994-1995, 1996-1997 Postdoctoral fellow, Duke University (with George J. Augustine)
1995-1996 Congressional Science Fellow, Senate Committee on Labor and Human Resources (with Senator Edward M. Kennedy)
1997-1999 Postdoctoral Member of Technical Staff, Biological Computation Res. Dept., Bell Labs Lucent Technologies (with David W. Tank and Winfried Denk)
2000-2006 Assistant Professor, Department of Molecular Biology, Princeton University
2006-2015 Associate Professor, Department of Molecular Biology and Princeton Neuroscience Institute, Princeton University
2015- **Professor, Neuroscience and Molecular Biology, Princeton University**
Associate, Program in Law and Public Affairs
Associate, Center for Information Technology Policy
Affiliate, Program in Cognitive Science
Affiliate, Program in Quantitative and Computational Biology

Honors and awards

1986 Tau Beta Pi, national engineering honor fraternity
1993 Grass Fellow, Marine Biological Laboratory, Woods Hole, Massachusetts
2000-2002 Alfred P. Sloan Research Fellowship
2000-2002 Rita Allen Foundation Scholar
2004-2009 W.M. Keck Distinguished Young Scholar in Medical Research
2004-2009 National Science Foundation Career Development Award
2009 AAAS/Subaru SB&F Prize for Excellence in Science Books
2012 Eden Autism Services – Emily Cavaliere Puzio and Frank Mauro Puzio Fellow
2016 Common Cause Gerrymandering Standard Writing Contest (*second prize*)
2018 Common Cause Gerrymandering Standard Writing Contest (*first prize*)

Professional society memberships

1986- Society for Neuroscience, member
2000- American Association for the Advancement of Science, member

**Policy, Data, and Legal Scholarship
(for Scientific Work, skip to page 5)**

GRANT AND FELLOWSHIP SUPPORT

Current support:

2017-2019 Educational Ventures, Inc.: New Horizons for Gerrymandering Prevention (\$375,000)

2018 Anonymous: New Horizons for Redistricting Reform (\$100,000)

2018-2019 The Eric and Wendy Schmidt Fund for Strategic Innovation: Seeding the Gerrymandering DataHub (\$250,000)

Past support:

1995-1996 Congressional Science and Engineering Fellow, American Association for the Advancement of Science (AAAS)

ADVISORY ROLES

1995-1996 Legislative assistant, Rep. Lloyd Doggett (D-TX). Advised on matters coming before the House Science Committee; energy; and environment issues.

1996 Legislative fellow, Senator Edward M. Kennedy (D-MA). Advised Senate Committee on Labor and Human Resources on higher education, research policy, and K-12 education technology issues. Reauthorization of the National Science Foundation and coordination of NetDay96, a day of wiring Massachusetts schools to the Internet.

2010- Rita Allen Foundation, Board of Directors

2015- New Jersey Governor's Council for Medical Research and Treatment of Autism. Appointed by Governor Chris Christie (R-NJ).

2017- Contributing editor, *The American Prospect*

U.S. SUPREME COURT AMICUS BRIEFS

Brief of Samuel S. Wang, Ph.D., in re Wesley W. Harris, et al., Appellants v. Arizona Independent Redistricting Commission, et al. in Support of Appellees, 2015-16 term, No. 14-232.

Brief of Heather K. Gerken, Jonathan N. Katz, Gary King, Larry J. Sabato, and Samuel S.-H. Wang as amici curiae in support of appellees, Beverly R. Gill, et al., Appellants, v. William Whitford et al., 2017-18 term, No. 16-1161. (cited in decision)

RESEARCH PUBLICATIONS (SEE ALSO SCIENTIFIC WORK)

S.S.-H. Wang (2015) Origins of Presidential poll aggregation: A perspective from 2004 to 2012. *International Journal of Forecasting* 31:898-909.

S.S.-H. Wang (2016) Three tests for practical evaluation of partisan gerrymandering. 68 *Stanford Law Review* 1263-1321.

S.S.-H. Wang (2016) Three practical tests for gerrymandering: application to Maryland and Wisconsin. *Election Law Journal*, 15:367-384.

S. Wang (2016) Q&A on neuroscience, elections, and statistics. *Neuron*, 92:290-293.

S.S.-H. Wang (2018) An antidote for gobbledygook: organizing the judge's partisan gerrymandering toolkit into a two-part framework. *Harvard Law Review Blog*, April 11, 2018.

S.S.-H. Wang, B.A. Remlinger, and B. Williams. An antidote for gobbledygook: organizing the judge's partisan gerrymandering toolkit into a two-part framework. *Election Law Journal*, forthcoming.

W.T. Adler and S.S.-H. Wang Response to Cho and Liu, "Sampling from complicated and unknown distributions: Monte Carlo and Markov chain Monte Carlo methods for redistricting." *Physica A*, in revision.

GENERAL-INTEREST WRITINGS AND OUTREACH

Podcast

6/2016-present Woodrow Wilson School's weekly podcast Politics And Polls (also called Woocast). Co-hosted with Julian Zelizer. On iTunes, regularly rated in Top 20 (News & Politics). Peak position, #8 News & Politics and Top 100 overall out of all ~250,000 podcasts.

Articles and public projects

Founder, Princeton Election Consortium, <http://election.princeton.edu>. 2004-2016. Over 18 million visits total. During election season, this site accounts for approximately one-fourth of web traffic to Princeton University.

Founder, Princeton Gerrymandering Project, <http://gerrymander.princeton.edu>. 2017-2018. Providing data and information resources on partisan gerrymandering.

Contributions on data science and elections to *Washington Post*, *New York Daily News*, *Los Angeles Times*, *Politico*, *The New Yorker.com*, *The New Republic*, and *The American Prospect*. 2008-2018.

The great gerrymander of 2012. *New York Times*, February 3, 2013, page SR1.

Sam Wang and Benjamin C. Campbell: Mr. Bayes goes to Washington: a review of *The Signal and The Noise* by Nate Silver. *Science*, February 15, 2013, 339:758-759.

Let math save our democracy. *New York Times*, December 6, 2015, page SR6.

GOP nomination rules tilt the playing field toward Donald Trump. *The American Prospect*, January 14, 2016.

The hardened divide in American politics. *The American Prospect*, Fall 2016, 12-13.

Why Trump stays afloat. *New York Times*, October 30, 2016.

Can math stop partisan gerrymandering? *Los Angeles Times*, May 5, 2017 (with Brian Remlinger).

A manageable federalist approach to partisan gerrymandering. *Election Law Blog*, September 4, 2017. <http://electionlawblog.org/?p=94580>

Slaying the partisan gerrymander. *The American Prospect*, Fall 2017 (with Brian Remlinger).

Can open data save gerrymandering reform? *The American Prospect*, June 25, 2018 (with Ben Williams and John O'Neill).

The states are now the best route to gerrymandering reform. *The American Prospect*, July 16, 2018 (with Ben Williams and Rick Ober).

Lawmakers should fix inequitable district lines (concerning open data in Bethune-Hill Virginia districts). *The Virginian-Pilot*, August 30, 2018 (with Ben Williams and Will Adler).

Why North Carolina Democrats should fight gerrymandering using state law. *Washington Post*, September 4, 2018 (with Rick Ober).

INVITED SEMINARS

2013 National Academy of Sciences, 150th Annual Meeting, break-out session on The New Science Of Elections, Washington, DC (chair: Douglas Massey).

2013 Opening symposium, Quantitative Collaborative program, College of Arts and Sciences, University of Virginia, Charlottesville, VA.

2013 Roundtable on elections and public opinion, CENTRA Technology, Arlington, VA.

2014 Tracking national elections with high time resolution. American Politics Research Seminar, Princeton University, Princeton, NJ.

2016 Stanford Law Review symposium on the Law of Democracy and the 2016 Election, Stanford Law School, Stanford, CA.

2016 Partisan gerrymandering convening, Brennan Center for Justice, NYU, New York, NY.

2016 Detecting and remedying partisan gerrymandering. American Politics Research Seminar, Princeton University, Princeton, NJ.

2016 Workshop on automatic voter registration, Brennan Center for Justice, NYU, New York, NY.

2016 D.E. Shaw Company, New York, NY.

2017 Symposium on partisan gerrymandering, Duke University Law School, Durham, NC.

2017 Quantitative Theory and Methods Institute (social sciences), Emory University, Atlanta, GA.

2018 Seminar on partisan gerrymandering, Columbia University Medical Center, New York, NY.

2012-2018 Annual presentation to fellows, Program in Law and Public Affairs, Princeton University, Princeton, NJ.

2018 Partisan gerrymandering convening, Brennan Center for Justice, NYU, New York, NY.

2018 Gerrymandering and independent redistricting conference, University of Arizona, Tucson, AZ.

2018 Hot topics in election law - redistricting and recent Supreme Court decisions, New Jersey Institute for Continuing Legal Education, New Brunswick, NJ.

INVITED PUBLIC TALKS

- 2016 The November election. SciCafe, American Museum of Natural History, New York, NY.
- 2016 (keynote) Lecture on election analysis, Strata/Hadoop conference, New York, NY.
- 2016 Public lecture associated with the 2016 U.S. Vice-Presidential debate, Longwood University, Farmville, VA.
- 2016 The November election (with Landon Jones). Princeton Public Library, Princeton, NJ.
- 2017 Yale CEO Summit, New York, NY.
- 2017 Public lecture on statistics and elections, Lafayette College, Easton, PA.
- 2017 Presentation on statistical inequities of the Electoral College. Stanford Law School, Stanford, CA.
- 2017 (keynote) Presentation on statistical inequities of the Electoral College. Making Every Vote Count, National Press Club, Washington, DC.
- 2018 Presentation on partisan gerrymandering, Nassau Club, Princeton, NJ.
- 2018 Presentation on partisan gerrymandering, Present Day Club, Princeton, NJ.

TEACHING AT PRINCETON

- S2017 FRS178 - Statistics, Journalism, and the Public Interest
- F2018 WWS 591b - Graduate policy workshop on election law and gerrymandering

Scientific Work
(for Policy and Legislative Work, see previous 5 pages)

GRANT AND FELLOWSHIP SUPPORT

Current support:

2002-2019 NIH R01 NS045193: Synaptic learning rules in the mammalian cerebellum (total: \$2,414,075 over 5 years)

2012-2018 Nancy Lurie Marks Family Foundation grant for autism research (Co-investigator with Mustafa Sahin and Wade Regehr; total: \$1,058,200, \$347,600 for S.W.)

2015-2018 NIH R21 EY026434: Use of calcium indicator proteins in spike counting mode (Co-investigator David DiGregorio; total: \$475,737, \$370,515 for S.W.)

2017-2022 NIH U19 NS104648: Mechanisms of neural circuit dynamics in working memory and decision-making (total: \$15,346,730 over five years; shared among seven investigators)

2017-2022 NIH R01 MH115750: Cerebellar determinants of flexible and social behavior on rapid time scales in autism model mice. (S.W. is lead PI; co-investigators Joshua Shaevitz and Jonathan Pillow; total: \$4,727,710 over 5 years)

Past support:

1990 Lerner-Gray Grant in Marine Zoology

1989, 1991 Earl and Ethel Myers Fellowship in Marine Biology

1991-1993 NIH predoctoral National Research Service Award

1994-1997 NIH postdoctoral National Research Service Award

2001-2004 Whitehall Foundation grant

2006 Writing residency at Rockefeller Foundation Study Center, Bellagio, Italy

2005-2007 New Jersey Governor's Council on Autism Pilot Grant

2004-2008 Human Frontier Science Project grant (Principal Investigator)

2004-2009 National Science Foundation Career Development Award

2010 NIH shared instrumentation grant for multiphoton microscope (PI)

2009-2011 NIH Challenge Grant (Co-investigator; PI Lynn Enquist)

2009-2011 NIH Challenge Grant (Co-investigator; PI David Tank)

2011-2012 Simons Foundation Autism Research Initiative (SFARI) Explorer grant

2012-2013 David A. Gardner '69 Magic Project, Princeton Council of the Humanities

2012-2015 McKnight Technological Innovations in Neuroscience award

2014-2017 NIH U01 NS090541 BRAIN Initiative grant (Co-investigator; PI Carlos Brody)

2015-2017 NIH R21 NS092320: Transcending dynamic and kinetic limits for neuronal calcium sensing

NON-UNIVERSITY COMMITTEES, COMMUNITY OUTREACH, AND SERVICE

NIH standing study section membership

2010-2014 Molecular Neurogenetics (MNG) 2010-2014

NIH ad hoc review, 2007-2017

2007 NIMH (Centers for Intervention Development and Applied Research, ZMH1 ERB-L)

2009 NIMH, National Institutes on Drug Abuse (CEBRA)

2013 Special Emphasis Panel for Brain Disorders and Clinical Neuroscience (BDCN) (ZRG1 BDCN-W (02))

2014 BRAIN Initiative: Transformative Approaches for Cell-Type Classification (ZMH1 ERB-M (06))

2014 BRAIN Initiative: Technologies for Large-scale Recording (ZNS1 SRB-G (77))

2015 Learning and Memory (LAM) study section, ad hoc

2015 Neuropharmacology (ZRG1 MDCN-R 94 S), ad hoc

2016 Special Emphasis Panel, ad hoc

Journal peer reviewing: *Biological Psychiatry, Biophysical Journal, Brain Behavior and Evolution, Brain Research, The Cerebellum, Cerebral Cortex, Chemical Biology, Current Biology, Election Law Journal, eLife, Frontiers in Neuroscience, J. Cell Biology, J. Comparative Neurology, J. Neurophysiology, J. Neuroscience, J. Neuroscience Methods, J. Physiology, Molecular and Cellular Neuroscience, Molecular Psychiatry, Nature, Nature Biotechnology, Nature Communications, Nature Methods, Nature Neuroscience, Nature Reviews Neuroscience, NeuroImage, Neuron, PLoS ONE, PNAS, Phil. Trans. Roy. Soc. B, and Science*

U.S. PATENT

Double-caged GABA: a novel light-activated probe as a neuroscience research tool. Application number 14/664,445, publication date September 14, 2015. Issued April 18, 2017 as U.S. Patent 9,625,448. D.D. Shi, M.F. Semmelhack, and S.S.-H. Wang.

RESEARCH PUBLICATIONS (>80 IN TOTAL; h-INDEX=35, i10-INDEX=61. SEE ALSO POLICY AND LEGISLATIVE WORK)

*The first two authors contributed equally to these works.

S.S. Wang, G.A. Ricaurte, and S.J. Peroutka (1987) ³H-3,4-methylenedioxymethamphetamine (MDMA; "Ecstasy") interactions with brain membranes and glass fiber filter paper. *European Journal of Pharmacology* 138:439-443.

S.S.-H. Wang, C.A. Mathis, and S.J. Peroutka (1988) R-2,5-Dimethoxy-4-⁷⁷bromoamphetamine (⁷⁷Br-R(-)-DOB), a novel radioligand [that] labels a 5-HT binding site subtype. *Psychopharmacology (Berlin)* 94:431-432.

S.J. Peroutka, A. Hamik, M.A. Harrington, C.A. Mathis, P.A. Pierce, and S.S.-H. Wang (1988) R-2,5-dimethoxy-4-⁷⁷bromoamphetamine [⁷⁷Br-R(-)DOB] labels a novel 5-hydroxytryptamine binding site in brain membranes. *Molecular Pharmacology* 34:537-542.

S.S. Wang and S.J. Peroutka (1989) Historical perspectives. In *The Serotonin Receptors*. (Ed. E. Sanders-Bush). Humana Press, pp. 3-20.

S.S.-H. Wang and S. Thompson (1992) A-type potassium channel clusters revealed using a new statistical analysis of loose patch data. *Biophysical Journal*, 63:1018-1025.

- C.A. Mathes, S.S.-H. Wang, H.M. Vargas, and S.H. Thompson (1992) Intracellular calcium release in N1E-115 neuroblastoma cells is mediated by the M1 muscarinic receptor subtype and is antagonized by McN-A-343. *Brain Research* 585:307-310.
- S.S.-H. Wang, C.A. Mathes, and S.H. Thompson (1993) Membrane toxicity of the protein kinase C inhibitor calphostin A by a free-radical mechanism. *Neuroscience Letters*, 157:25-28. (published in error a second time as 156:145-148)
- S.S.-H. Wang (1993) Modeling the apparent diffusion constant of calcium ions emanating from a channel: implications for calcium wave propagation. *Biological Bulletin*, 185:297-298.
- S.S.-H. Wang and S.H. Thompson (1994) Measurement of changes in muscarinic and histaminergic receptor density in single neuroblastoma cells using calcium release desensitization. *Cell Calcium*, 15:483-496.
- S.S.-H. Wang, A.A. Alousi, and S.H. Thompson (1995) The lifetime of inositol 1,4,5-trisphosphate in single cells. *Journal of General Physiology*, 105:149-171.
- S.S.-H. Wang and S.H. Thompson (1995) Local positive feedback by calcium in the propagation of intracellular calcium waves. *Biophysical Journal*, 69:1683-1697.
- DeBello, W.M., V. O'Connor, T. Dresbach, S.W. Whiteheart, S.S.-H. Wang, F.E. Schweizer, H. Betz, J.E. Rothman, and G.J. Augustine (1995) SNAP-mediated protein-protein interactions essential for neurotransmitter release. *Nature*, 373:626-630.
- S.S.-H. Wang and G.J. Augustine (1995) Confocal imaging and local photolysis of caged compounds: dual probes of synaptic function. *Neuron*, 15:755-760.
- M.E. Burns, S.A. Beushausen, G.J. Chin, D. Tang, W.M. DeBello, T. Dresbach, V. O'Connor, F.E. Schweizer, S.S.-H. Wang, S.W. Whiteheart, H. Betz, J.E. Rothman, and G.J. Augustine (1995) Proteins involved in synaptic vesicle docking and fusion. *Cold Spring Harb. Symp. Quant. Biol.* 60:337-348.
- G.J. Augustine, H. Betz, K. Bommert, M.P. Charlton, W.M. DeBello, T. Dresbach, J.M. Hunt, V. O'Connor, F.E. Schweizer, S.S.-H. Wang, and S.W. Whiteheart (1996) Molecular mechanisms of neurotransmitter secretion: functional studies at the squid giant synapse. In *Basic neuroscience in invertebrates*. (Ed. H. Koike, Y. Kidokoro, K. Takahashi, T. Kanaseki) Japan Scientific Societies Press.
- R. Kupferman, P.P. Mitra, P.C. Hohenberg, and S.S.-H. Wang (1997) Analytical calculation of intracellular calcium wave characteristics. *Biophysical Journal*, 72:2430-2444.
- A.E. Schivell, S.S.-H. Wang, and S.H. Thompson (1997) Behavioral modes arise from a random process in the nudibranch *Melibe*. *Biological Bulletin*, 192:418-425.
- D.L. Pettit*, S.S.-H. Wang*, K.R. Gee, and G.J. Augustine (1997) Chemical two-photon uncaging: a novel approach to mapping glutamate receptors. *Neuron*, 19:465-471.
- G.J. Augustine, E.A. Finch, and S.S.-H. Wang (1998) The spatial range of dendritic signals for cerebellar long-term depression: studies with local photolysis of caged compounds. In *Integrative aspects of calcium signalling*. (Ed. A. Verkhratsky and E.C. Toescu). Plenum Press.

T. Furuta, S.S.-H. Wang, J.L. Dantzker, T.M. Dore, W.J. Bybee, E.M. Callaway, W. Denk, and R.Y. Tsien (1999) Brominated 7-hydroxycoumarin-4-ylmethyls: novel photolabile protecting groups with biologically useful cross-sections for two photon photolysis. ***Proc. Natl. Acad. Sci. USA***, 96:1193-1200.

S.S.-H. Wang and G.J. Augustine (1999) Calcium signaling in neurons: a case study in cellular compartmentalization. In *Calcium as a cellular regulator*. (Ed. E. Carafoli and C.B. Klee) Oxford University Press, pp. 545-566.

G.J. Augustine, D.L. Pettit, and S.S.-H. Wang (1999) Spatially resolved flash photolysis via chemical two-photon uncaging. In *Imaging: a laboratory manual*. (Eds. R. Yuste, F. Lanni, A. Konnerth) Cold Spring Harbor Press.

S.S.-H. Wang, L. Khiroug, and G.J. Augustine (2000) Quantification of spread of cerebellar long-term depression with chemical two-photon uncaging of glutamate. ***Proc. Natl. Acad. Sci. USA***, 97:8635-8640.

S.S.-H. Wang, W. Denk, and M. Häusser (2000) Coincidence detection in single dendritic spines mediated by calcium release. ***Nature Neuroscience***, 3:1266-1273.

D.A. Clark, P.P. Mitra, and S.S.-H. Wang (2001) Scalable architecture in mammalian brains. ***Nature***, 411:189-193 (also see News & Views by Kaas and Collins, 411:141-142).

S.S.-H. Wang, P.P. Mitra, and D.A. Clark (2002) How did brains evolve? ***Nature***, 415:135 (also see Communications Arising by Sultan and Barton, 415:133-135).

K.H. Harrison, P.R. Hof, and S.S.-H. Wang (2002) Scaling laws in the mammalian neocortex: does form provide clues to function? ***Journal of Neurocytology***, 30:289-298.

J. DeFelipe, G.N. Elston, I. Fujita, J. Fuster, K.H. Harrison, P.R. Hof, Y. Kawaguachi, K.A.C. Martin, K.S. Rockland, A.M. Thomson, S.S.-H. Wang, E.L. White, and R. Yuste (2002) Neocortical circuits: Evolutionary aspects and specificity versus non-specificity of synaptic connections. Remarks, main conclusions and general comments and discussion. ***Journal of Neurocytology***, 30:387-416.

S.S.-H. Wang and G. Major (2003) Integrating over time with dendritic wave-fronts. ***Nature Neuroscience***, 6:906-908.

M.J. Burish, H.Y. Kueh, and S.S.-H. Wang (2004) Brain architecture and social complexity in modern and ancient birds. ***Brain, Behavior and Evolution***, 63:107-124.

K.D. Wyatt, P. Tanapat, and S.S.-H. Wang (2005) Speed limits in the cerebellum: constraints from myelinated and unmyelinated parallel fibers. ***European Journal of Neuroscience***, 31:2285-2290.

D.H. O'Connor, G.M. Wittenberg, and S.S.-H. Wang (2005) Initiation of graded bidirectional synaptic plasticity by step-like unitary events. ***Proc. Natl. Acad. Sci. USA***, 102:9679-9684. doi:10.1073/pnas.0502332102.

D.H. O'Connor, G.M. Wittenberg, and S.S.-H. Wang (2005) Dissection of bidirectional synaptic plasticity into saturable unidirectional processes. ***Journal of Neurophysiology***, 94:1564-1572. doi:10.1152/jn.00047.2005.

- M.R. Sullivan, A. Nimmerjahn, D.V. Sarkisov, F. Helmchen, and S.S.-H. Wang (2005) *In vivo* calcium imaging of circuit activity in cerebellar cortex. ***Journal of Neurophysiology***, 94:1635-1643. doi:10.1152/jn.01013.2004.
- S. Shoham*, D.H. O'Connor*, D.V. Sarkisov, and S.S.-H. Wang (2005) Rapid neurotransmitter uncaging in spatially defined patterns. ***Nature Methods***, 3:837-843. doi:10.1038/NMETH793.
- S.M. Thompson, J.P.Y. Kao, R.H. Kramer, K.E. Poskanzer, R.A. Silver, D. Digregorio, and S.S.-H. Wang (2005) Flashy science: controlling neural function with light (Mini-symposium review). ***Journal of Neuroscience***, 25:10358-10365.
- G.M. Wittenberg and S.S.-H. Wang (2006) Malleability of spike-timing-dependent plasticity at the CA3-CA1 synapse. ***Journal of Neuroscience***, 26:6610-6617. doi:10.1523/JNEUROSCI.5388-05.2006.
- D.V. Sarkisov and S.S.-H. Wang (2006) Alignment and calibration of a focal neurotransmitter uncaging system. ***Nature Protocols***, 2:828-832. doi:10.1038/nprot.2006.124.
- D.H. O'Connor, G.M. Wittenberg, and S.S.-H. Wang (2007) Timing and contributions of pre-synaptic and post-synaptic parameter changes during unitary plasticity events at CA3-CA1 synapses. ***Synapse***, 61:664-678.
- D.V. Sarkisov, S.E. Gelber, J.W. Walker, and S.S.-H. Wang (2007) Synapse-specificity of calcium release probed by chemical two-photon uncaging of IP₃. ***Journal of Biological Chemistry***, 282:25517-25526.
- D.V. Sarkisov and S.S.-H. Wang (2007) Uncaging techniques combined with patch clamp recordings. In *Patch clamp methods: Advanced Techniques (Neuromethods)*, 2nd edition. Editor: W. Walz. Humana Press.
- G.M. Wittenberg and S.S.-H. Wang (2007) Evolution and scaling of dendrites. In *Dendrites*, 2nd edition. Editors: M. Häusser, N. Spruston and G. Stuart. Oxford University Press.
- N.J. Kaslow, A.M. Bollini, B. Druss, L.R. Goldfrank, A.M. La Greca, S.S.-H. Wang, R.L. Glueckauf, K.J. Kelleher, R.E. Varela, L. Weinreb, and L. Zeltzer (2007) Health care for the whole person: Research update. ***Professional Psychology - Research And Practice***, 38:278-289.
- D.V. Sarkisov and S.S.-H. Wang (2008) Order-dependent coincidence detection in cerebellar Purkinje neurons at the inositol trisphosphate receptor. ***Journal of Neuroscience***, 28:133-142.
- S.S.-H. Wang, J.R. Shultz, M.J. Burish, K.H. Harrison, P.R. Hof, L.C. Towns, M.W. Wagers, and K.D. Wyatt (2008) Functional trade-offs in white matter axonal scaling. ***Journal of Neuroscience***, 28:4047-4056.
- I. Ozden*, H.M. Lee*, M.R. Sullivan, and S.S.-H. Wang (2008) Identification and clustering of event patterns from *in vivo* multiphoton optical recordings of neuronal ensembles. ***Journal of Neurophysiology***, 100:495-503.

S.S.-H. Wang (2008) Functional tradeoffs in axonal scaling: implications for brain function. *Brain, Behavior and Evolution*, 72:159-167.

F. Helmchen, S.S.-H. Wang, and W. Denk (2009) Multiphoton imaging in neuroscience. In *Biomedical Optical Imaging*. Editors: J.G. Fujimoto and D. Farkas. Oxford University Press.

T.M. Hoogland*, B. Kuhn*, W. Göbel, W. Huang, J. Nakai, F. Helmchen, S.J. Flint, and S.S.-H. Wang (2009) Radially expanding transglial calcium waves in the intact cerebellum. *Proc. Natl. Acad. Sci. USA*, 106:3496-3501.

I. Ozden*, M.R. Sullivan*, H.M. Lee, and S.S.-H. Wang (2009) Reliable coding emerges from coactivation of climbing fibers in microbands of cerebellar Purkinje neurons. *Journal of Neuroscience*, 29:10463-10473.

A.E. Granstedt, M.L. Szpara, B. Kuhn, S.S.-H. Wang, and L.W. Enquist (2009) Fluorescence-based monitoring of activity in virally traced neural circuits. *PLoS ONE*, 9:e6923.

S. Wang (2009) Research highlight: a neuroscientist explores the energetic efficiency of the brain. *Nature*, 461:851.

A.E. Granstedt, B. Kuhn, S.S.-H. Wang, and L.W. Enquist (2010) Calcium imaging of neuronal circuits in vivo using a circuit-tracing pseudorabies virus. *Cold Spring Harbor Protocols*, 2010(4):pdb.prot5410.

H.Z. Shouval, S.S.-H. Wang, and G.M. Wittenberg (2010) Spike timing dependent plasticity: a consequence of more fundamental learning rules. Invited review, special issue on spike timing dependent plasticity, *Frontiers in Neuroscience* 4:19, ed. H. Markram, P.J. Sjöström, W. Gerstner. doi:10.3389/fncom.2010.00019

B. Kuhn, T.M. Hoogland, and S.S.-H. Wang (2011) In vivo calcium imaging of cerebellar glia with synthetic and genetic indicators. In *Imaging in neuroscience: a laboratory manual*. (Eds. F. Helmchen, A. Konnerth) Cold Spring Harbor Press. (published in *CSH Protocols* as <http://pubmed.gov/21969619>, <http://pubmed.gov/21969620>, and <http://pubmed.gov/21969621>)

E.F. Civillico, S. Shoham, D.V. Sarkisov, and S.S.-H. Wang (2011) Acousto-optical detector-based patterned ultraviolet-uncaging of neurotransmitter for the study of neuronal integration. In *Imaging in neuroscience: a laboratory manual*. (Eds. F. Helmchen, A. Konnerth) Cold Spring Harbor Press. In press.

E.F. Civillico, J.P. Rickgauer, and S.S.-H. Wang (2011) Targeting and excitation of photoactivatable molecules: design considerations for neurophysiology experiments. In *Photosensitive molecules for controlling biological function*. Editors: J.J. Chambers and R.H. Kramer. New York: Humana Press.

B.C. Campbell and S.S.-H. Wang (2012) Familial linkage between neuropsychiatric disorders and intellectual interests. *PLoS ONE*, 7(1):e30405. doi:10.1371/journal.pone.0030405 (#4 most-viewed in 30 days)

X.R. Sun, A. Giovannucci, A.E. Sgro, and S.S.-H. Wang (2012) SnapShot: Optical control and imaging of brain activity. *Cell*, 149:1650-1652. doi:10.1016/j.cell.2012.06.009

- *B. Kuhn, *I. Ozden, Y. Lampi, M.T. Hasan, and S.S.-H. Wang (2012) An amplified promoter system for targeted expression of calcium indicator proteins in the cerebellar cortex. *Frontiers in Neural Circuits*, 6:49, doi:10.3389/fncir.2012.00049.
- *I. Ozden, *D.A. Dombeck, T.M. Hoogland, D.W. Tank, and S.S.-H. Wang (2012) Widespread state-dependent shifts in cerebellar activity in locomoting mice. *PLoS ONE*, 7(8):e42650. doi:10.1371/journal.pone.0042650
- *J. Akerboom, *T.-W. Chen, T.J. Wardill, L. Tian, J.S. Marvin, S. Mutlu, N. Carreras Calderón, F. Esposti, B.G. Borghuis, X.R. Sun, A. Gordus, M.B. Orger, R. Portugues, F. Engert, J.J. Macklin, A. Filosa, A. Aggarwal, R. Kerr, R. Takagi, S. Kracun, E. Shigetomi, B.S. Khakh, H. Baier, L. Lagnado, S.S.-H. Wang, C.I. Bargmann, B.E. Kimmel, V. Jayaraman, K. Svoboda, D.S. Kim, E.R. Schreiter, L.L. Looger (2012) Optimization of a GCaMP calcium indicator for neural activity imaging. *Journal of Neuroscience*, 32:13819-13840.
- E.R. Schneider, E.F. Civillico, S.S.-H. Wang (2013) Regulation of calcium-based dendritic excitability in the deep cerebellar nuclei. *Journal of Neurophysiology*, 109:2282-2292.
- *X.R. Sun, *A. Badura, D. A. Pacheco, L.A. Lynch, E.R. Schneider, M.P. Taylor, I.B. Hogue, L.W. Enquist, M. Murthy, S.S.-H. Wang (2013) Fast GCaMPs for improved tracking of neuronal activity. *Nature Communications*, 4:2170. doi:10.1038/ncomms3170.
- D.D. Shi, F.F. Trigo, M.F. Semmelhack, S.S.-H. Wang (2014) Synthesis and biological properties of *bis*-CNB-GABA, a photoactivatable neurotransmitter with low receptor interference and chemical two-photon uncaging properties. *Journal of the American Chemical Society*, 36:1976-1981. doi:10.1021/ja411082f.
- *F. Najafi, *A. Giovannucci, S.S.-H. Wang, J.F. Medina (2014) Analog stimulus encoding in individual Purkinje cell dendrites of awake mice. *Cell Reports*, 6:1-7.
- S.S.-H. Wang, A.D. Kloth, and A. Badura (2014) The cerebellum, sensitive periods, and autism (Perspective). *Neuron*, 83:518-532. doi:10.1016/j.neuron.2014.07/016
- F. Najafi, A. Giovannucci, S.S.-H. Wang, and J.F. Medina (2014) Coding of stimulus strength via analog calcium signals in Purkinje cell dendrites of awake mice. *eLife*, 3:e03663. doi:10.7554/eLife.03663
- A. Badura, X.R. Sun, A. Giovannucci, L.A. Lynch, and S.S.-H. Wang (2014). Fast calcium sensor proteins for monitoring neural activity. *Neurophotonics*, 1(2):025008.
- T. Schoenfeld, A.D. Kloth, B. Hsueh, M.B. Runkle, S.S.-H. Wang, and E. Gould (2014). Gap junctions in the ventral hippocampal-medial prefrontal pathway are involved in anxiety regulation. *Journal of Neuroscience*, 34:15679-15688.
- C. Piochon, A.D. Kloth, G. Grasselli, H. Tittley, H. Nakayama, K. Hashimoto, V. Wan, D.H. Simmons, T. Eissa, J. Nakatani, A. Cherskov, T. Miyazaki, M. Watanabe, T. Takumi, M. Kano, S.S.-H. Wang, and C. Hansel (2014). Cerebellar plasticity and motor learning in a copy number variation mouse model of autism. *Nature Communications*, 5:5586.
- S.S.-H. Wang (2015) Origins of Presidential poll aggregation: A perspective from 2004 to 2012. *International Journal of Forecasting* 31:898-909. doi:10.1016/j.ijforecast.2015.01.003

A.D. Kloth, A. Badura, A. Li, A. Cherskov, S. G. Connolly, A. Giovannucci, M.A. Bangash, G. Grasselli, O. Peñagarikano, C. Piochon, P.T. Tsai, D. Geschwind, C. Hansel, M. Sahin, T. Takumi, P.F. Worley, and S.S.-H. Wang (2015) Cerebellar associative sensory learning defects in five mouse autism models..*eLife*, 4:e06085. doi:10.7554/eLife.06085

S.S.-H. Wang, A.E. Ambrosini, and G.M. Wittenberg (2015) Evolution and scaling of dendrites. In *Dendrites*, 3rd edition. Editors: M. Häusser, N. Spruston and G. Stuart. Oxford University Press.

E. Cope, B. Briones, A. Brockett, S. Martinez, P.-A. Vigneron, M. Opendak, S.S.-H. Wang, and E. Gould (2016) Immature neurons and radial glia, but not astrocytes or microglia, are altered in adult *Cntnap2* and *Shank3* mice, models of autism. *eNeuro*, 3(5).

A. Giovannucci*, A. Badura*, B. Deverett, F. Najafi, T.D. Pereira, Z. Gao, I. Ozden, A.D. Kloth, E. Pnevmatikakis, L. Paninski, C.I. De Zeeuw, J.F. Medina, S.S.-H. Wang (2017) Cerebellar granule cells acquire a widespread predictive feedback signal during motor learning. *Nature Neuroscience*, 20(5):727-734.

A. Giovannucci, E. Pnevmatikakis, T.D. Pereira, B. Deverett, M.J. Brady, J. Fondriest, D.M. Rodo, S.S.-H. Wang, W. Abbas (2017) Automated gesture tracking in head-fixed mice. *Journal of Neuroscience Methods*, pii: S0165-0270(17)30250-30259.

B. Deverett, S.A. Koay, M. Oostland, and S.S.-H. Wang (2018) Cerebellar involvement in an evidence-accumulation decision-making task. *eLife*, 7:e36781. DOI: [10.7554/eLife.36781](https://doi.org/10.7554/eLife.36781)

A. Badura, J.L. Verpeut, J.M. Metzger, T.D. Pereira, T.J. Pisano, B. Deverett, D. Bakshinskaya, and S.S.-H. Wang (2018) Normal cognitive and social development require posterior cerebellar activity. *eLife*, 7:e36401.

T.D. Pereira, D. Aldarondo, L. Willmore, M. Kislin, S.S.-H. Wang, M. Murthy, and J.W. Shaevitz (2018) Fast animal pose estimation using deep neural networks. *Nature Methods*, forthcoming.

J.S. Marvin, B. Scholl, D.E. Wilson, K. Podgorski, A. Kazemipour, J.A. Müller, S. Schoch-McGovern, N. Rebola, F.J. Urrea Quiroz, H. Bao, J.P. Little, A.N. Tkachuk, E. Cai, A.W. Hantman, S.S.-H. Wang, V. dePiero, B.G. Borghuis, E.R. Chapman, D. Dietrich, D.A. DiGregorio, D. Fitzpatrick, and L.L. Looger (2018) Stability, affinity and chromatic variants of the glutamate sensor iGluSnFR. *Nature Methods*, forthcoming.

S.S.-H. Wang, B.A. Remlinger, and B. Williams. An antidote for gobbledygook: organizing the judge's partisan gerrymandering toolkit into a two-part framework. *Election Law Journal*, forthcoming.

W.T. Adler and S.S.-H. Wang Response to Cho and Liu, "Sampling from complicated and unknown distributions: Monte Carlo and Markov chain Monte Carlo methods for redistricting." *Physica A*, in revision.

B. Deverett, M. Kislin, M. Oostland, D.W. Tank, and S.S.-H. Wang. Cerebellar disruption impairs working memory during decision-making. In preparation.

H.K. Titley, M. Kislin, D.H. Simmons, S.S.-H. Wang, and C. Hansel. Complex-spike clusters provide false-positive rejection for a cerebellar supervised learning rule. In preparation.

Y. Shulgina, K.N. Vodrahalli, D.C. Pinto, and S.S.-H. Wang. Shared heritable mechanisms between neuropsychiatric disorders and normal-range personality traits. In preparation.

A.D. Kloth, B.C. Campbell, R.D. Jones, and S.S.-H. Wang. Bayesian learning in a cerebellar conditioning task. In preparation.

K.N. Vodrahalli, Y. Shulgina, Y.L. Kim, T. Kuhn, and S.S.-H. Wang. Machine learning-based classification of intellectual phenotypes. In preparation.

GENERAL-INTEREST WRITINGS AND OUTREACH

Books

Sandra Aamodt and Sam Wang: *Welcome To Your Brain: Why You Lose Your Car Keys but Never Forget How to Drive and Other Puzzles of Everyday Life*. Bloomsbury USA. In US English (March 2008), paperback, and 24 international translations.

Sandra Aamodt and Sam Wang: *Welcome To Your Child's Brain: How The Mind Grows From Conception To College*. Bloomsbury USA. In US English (September 2011), paperback, and 15 international translations.

Articles

With Sandra Aamodt and Joshua Gold: contributions on neuroscience, *New York Times*, *London Times*, *Washington Post*, *USA Today*, *Bloomberg View*, *New York Post*, *Cerebrum*, and *Physics World*. 2007-2012.

How to think about the risk of autism. *New York Times*, March 30, 2014, page SR6-SR7.

From birth onward, our experience of the world is dominated by the brain's continual conversation with itself. From *Think tank: forty neuroscientists explore the biological roots of human experience*. Ed. David J. Linden. Yale University Press, publication date April 2018.

UNIVERSITY AND DEPARTMENTAL SERVICE

Molecular Biology:

2000-2011 Department of Molecular Biology Seminar Committee

2001 Symposium planner, Dynamics in Biological Networks
(with S. Tilghman and S. Tavazoie)

2008-2011 Graduate Committee, Department of Molecular Biology

2010 Departmental grant for rapid-scanning Prairie multiphoton microscopy
(S10 RR026665)

Spring 2017 Oversight of Statistics and Machine Learning 201 (SML 201)

Neuroscience:

2003-present Executive Committee, Program in Neuroscience (term expires 6/2016)
 2008-2012 Curriculum Committee, Neuroscience Institute
 2008-2012 Graduate Admissions Committee, Neuroscience Ph.D. Program
 2010-present C.V. Starr Fellowship Committee, Neuroscience Institute
 2013-2014 Neuroscience Institute, junior faculty search committee
 2013-present Graduate Admissions Committee, Neuroscience Ph.D. Program
 Fall 2017 Reorganization and course directorship, NEU501A (core graduate course)
 2017-2018 Search committee, faculty recruitment in molecular/cellular neuroscience

University:

2001-2002 Fellow, Rockefeller College
 2003-2007 Adviser, Forbes College
 2005-2008 University Committee on Committees
 2006-2010 University Committee on Public Lectures, chair (two terms)
 2006-2008 Curriculum Committee, Undergraduate Certificate in Neuroscience program
 2007-present Fellow, Forbes College
 2010 Freshman address speaker, Class of 2014
 2008-2011 Institutional Animal Care and Use Committee, chair
 2009-2011 Fellow, Old Dominion
 2013, Fall University Committee on Committees (one term only, vacancy substitution)
 2014 Animal Research Communications Working Group, Office of Dean for
 Research
 2014, Fall University Committee on Committees (one term only, vacancy substitution)
 2015-2017 University Institutional Biosafety Committee
 2016-2017 University Committee on Student Life
 2017-2018 Faculty Advisory Committee on Appointments and Advancements (C/3)
 2018-2019 University Institutional Biosafety Committee

ADVISEES AND TRAINEES

Undergraduate students:

(36 students: 18 MOL, 4 NEU, 3 PHY, 3 PSY, 3 COS, 3 independent concentrators, 1 EEB, 1 CHM)

Damon Clark '01 (Physics) As his junior independent work, defined the cerebrotypes as a measure of brain scaling. This work was published in *Nature*. Ph.D. Harvard Univ.; now faculty, Yale MCDB.

Jennifer Shultz '01 (Molecular Biology) Shultz's senior year work investigated axon scaling across brain evolution. Her project received a departmental best thesis award and launched a major project published in the *Journal of Neuroscience*. M.D. Univ. of Iowa, now attending dermatologist, Austin, TX.

Mark Burish '02 (Molecular Biology) Burish's senior thesis on bird brain evolution was published in *Brain, Behavior and Evolution*. M.D./Ph.D. Vanderbilt Univ.; now fellowship in neurology at UCSF.

Hao Yuan Kueh '02 (Physics) Kueh and Burish collaborated on the bird project. Ph.D. Harvard Univ.; now at Caltech.

Matthew Wagers '03 (Molecular Biology) Wagers contributed to the Shultz axon scaling project. Ph.D. Univ. of Maryland; now faculty in linguistics, UC Santa Cruz.

Samuel Hall '03 (Molecular Biology) Hall's senior thesis on neural prosthetics received a departmental best thesis award and was published in *Slate*. Wall Street; Ph.D. U. Cambridge.

Lily Johnston '05 (Psychology) Johnston worked on scaling of cerebellar neurons. M.D. UCSD, now Department of Surgery and School of Public Health, Johns Hopkins University.

Varun Phadke '05 (Molecular Biology) Worked on scaling of bird brains and cerebellar neurons. Phadke was the Class of 2005 valedictorian. M.D. Harvard Medical School (M.D.)

David Matthews '05 (Molecular Biology) Worked on cerebellar synaptic learning rules. Consultant, Boston Consulting Group.

Chelsea Meskunas '06 (Molecular Biology) Reviewed overuse of headache medication. Senior thesis was published in *Headache*. M.D. Mount Sinai, now a resident in neurology.

Natalia Balko '07 (Molecular Biology) M.B.A. candidate Stanford, now at IMS Consulting.

Jonathan Charlesworth '07 (Molecular Biology) Worked on in vivo cerebellar imaging. Ph.D. UCSF, now senior scientist, at Neurotek/thync.

Justin Huynh '07 (Molecular Biology) Worked on cerebellar synaptic learning rules. Now director at Liquidware.

Hyunyoung Megan Lee '08 (Independent Concentration, Computational Biology) Developed clustering algorithms for analyzing in vivo imaging. M.D. University of Maryland.

Andrew Bluher '09 (Molecular Biology) Worked on canine brain scaling. M.D. University of Maryland.

Shihab Ali '11 (Molecular Biology) Worked on canine brain scaling. M.D. study, Brown University.

Charlotte Arlt '11 (University of Cologne) Developed in vivo imaging methods. Ph.D. study, University College London.

David Tsao '11 (Physics) Developed in vivo imaging methods.

Diya Das '12 (Molecular Biology) Worked on canine brain scaling. Das's senior thesis received a Neuroscience Institute best thesis award. Ph.D. study at UC Berkeley.

Daniel Chang '13 (Molecular Biology) Worked on calcium sensor design. Post-baccalaureate.

Sara Connolly '13 (Ecology & Evolutionary Biology) Eyeblink conditioning in autism model mice. Now studying for a Ph.D. at Stanford University.

Tierney Kuhn '13 (Computer Science) Developed methods for genomic and phenotypic analysis of intellectual interests. Now at Microsoft Research.

Diana Shi '13 (Psychology) Developed a new caged GABA compound for emulating inhibition in intact brain tissue. Shi received a best thesis award and published her work in *Journal of the American Chemical Society*. Now studying for an M.D. at Harvard Medical School.

Richard D. Jones '13 (Psychology) Discovered backward blocking, a form of Bayesian learning, in cerebellar learning. Post-baccalaureate.

Amy Li '14 (Molecular Biology) Investigated eyeblink conditioning in autism model mice. Now studying for an M.D. at Stanford University.

Adriana Cherskov '14 (Molecular Biology) Investigated eyeblink conditioning in autism model mice. Now Gates Scholar at Cambridge University. Planning M.D./Ph.D. study at Columbia University.

Yekaterina Shulgina '15 (Molecular Biology) Genomic analysis of normal-range traits in relatives of persons with autism. Shulgina received the John Brinster '43 prize for best neuroscience thesis, and the Sigma Xi book prize for best molecular biology thesis. Now studying for a Ph.D. at Harvard University.

Thaddeus Weigel '15 (Molecular Biology) Tracing of synaptic pathways from cerebellum to forebrain. Post-baccalaureate at NIH.

Kiran Vodrahalli '16 (Computer Science) Clustering analysis of intellectual phenotypes.

Julia Metzger '16 (Molecular Biology) Cerebellar roles in development of nonmotor functions. Metzger received the the best thesis award in Quantitative and Computational Biology and an outstanding thesis award in Molecular Biology.

Shruthi Deivasigamani '16 (Molecular Biology) Tracing of synaptic pathways from cerebellum to forebrain.

Christine Hildreth '16 (Independent Concentration, Neuroscience) Cerebellar roles in development of nonmotor functions.

Marissa Applegate '16 (Chemistry) Acceleration of Fast-GCaMP responses for tracking neuronal activity. Studying for a Ph.D. in neuroscience at Columbia University.

Alice J. Tao '17 (Neuroscience) Contributions of cerebellar activity to cognitive and social behavior in mice. Tao received the John Brinster '43 Senior Thesis Prize in Neuroscience.

Joyce C. Lee '17 (Neuroscience).

Rob Aguilar '17 (Computer Science). Convolutional neural networks for recognizing neurons in fluorescence images.

B.C. Cho '18 (Electrical Engineering)

Alicia Lai '18 (Neuroscience)

Lawrence Tao '19 (Neuroscience)

Patricia Aguiar '19 (Neuroscience)

Christina Matl '19 (Molecular Biology)

Postdoctoral research associates (fellowships):

Shy Shoham (2001-2005) Dr. Shoham arrived at Princeton as a Lewis Thomas Fellow. He designed and constructed a system for uncaging neurotransmitters to activate brain tissue in defined patterns. He is now a professor at the Technion in Israel.

Bernd Kuhn (2004-2010) Dr. Kuhn developed methods for cell-type-specific expression of calcium indicator proteins, and imaging them in vivo. He is now a Group Leader at Okinawa Institute of Science and Technology

Ilker Ozden (2004-2010) Dr. Ozden pioneered the use of calcium-sensitive indicator proteins for imaging cerebellar circuitry. He was an Autism Speaks postdoctoral fellow, and is now on the faculty at University of Missouri Columbia.

Tycho Hoogland (2005-2009) Dr. Hoogland discovered waves of activity encompassing hundreds of glial cells in cerebellum. He is now a postdoctoral researcher at the Netherlands Institute for Neuroscience.

Eugene Civillico (2006-2009) Dr. Civillico was a Patterson Trust postdoctoral fellow. He used patterned uncaging methods to discover rules for local signal summation in cerebellar Purkinje cell dendrites. He is now a research program official at the US Food and Drug Administration.

Stephen Lin (2010-2011) Dr. Lin is a former research group leader from Wyeth Labs. At Princeton he investigated signaling properties of calcium signaling proteins. He is now retired.

P. Alexander Argüello (2010-2012) Dr. Argüello traced synaptic pathways between frontal cortex and cerebellum. He is now a program officer at NIMH.

Andrea Giovannucci (2010-present) Dr. Giovannucci is discovering how the cerebellum encodes learned stimuli during eyeblink conditioning, a form of cerebellar learning. He was a New Jersey Commission on Brain Injury Research postdoctoral scholar. He is now a researcher at the Flatiron Institute of the Simons Foundation.

Aleksandra Badura (2012-present) Dr. Badura is testing the hypothesis that the cerebellum acts during developing as a teacher of higher cognitive processes. She is also developing and testing fast-responding fluorescent calcium sensor proteins..She recently received a Veni career development fellowship from the Netherlands Organization for Scientific Research (NWO).

Jessica Verpeut (July 2015-present) Dr. Verpeut is testing the hypothesis that the cerebellum acts during developing as a teacher of higher cognitive processes. She is currently a New Jersey Commission on Brain Injury Research postdoctoral scholar.

Mikhail Kislin (August 2015-present) Dr. Kislin is using the monitoring of freely-moving mice to test the hypothesis that the cerebellum carries information specific to the performance of cognitive tasks.

Kelly Seagraves (February 2016-present) Dr. Seagraves is a C.V. Starr Fellow hosted by the Wang laboratory. She is interested in neural mechanisms of social learning in freely behaving rodents.

Junuk Lee (September 2017-present).

Marlies Oostrand (expected January 2018).

Henk-Jan Boele (expected August 2018).

Joseph Broussard (expected September 2018).

Graduate students (fellowships underlined):

Dmitry Sarkisov (2000-2007, Ph.D. Physics) Sarkisov studied coincidence detection by IP₃ single dendritic spines of cerebellar Purkinje neurons. Now in financial industry.

Gayle Wittenberg (2001-2003, Ph.D. Molecular Biology, 2003-2006 Council on Science and Technology teaching fellow) Wittenberg studied spike timing dependent plasticity in hippocampus. Now a group leader at Janssen Research.

Kim Hatch Harrison (2002-Spring 2003; M.A. in Molecular Biology) Harrison studied evolutionary scaling principles of axons.

Daniel O'Connor (2002-2006; M.A. Psychology, Ph.D. Molecular Biology) O'Connor held a National Science Foundation Graduate Fellowship. He studied learning rules at single hippocampal synapses, and developed patterned uncaging methods. Now an associate professor at Johns Hopkins University.

Megan Sullivan (2002-2006; Ph.D. Molecular Biology) Sullivan held a National Alliance for Autism Research graduate fellowship. Sullivan pioneered in vivo imaging of cerebellar circuitry.

Eve Schneider (2007-2012; Ph.D. Psychology) Schneider discovered dendritic excitability in the deep cerebellar nuclei. Now at Yale University.

Xiaonan Richard Sun (2007-2012; Ph.D. Molecular Biology, M.D. at UMDNJ) Sun developed Fast-GCaMP sensors for rapid sensing of neuronal calcium. Now in neurosurgery fellowship at North Shore Long Island Jewish Hospital.

Alexander Kloth (2009-present; Ph.D. Molecular Biology and Neuroscience) Kloth discovered cerebellar circuit defects in a wide variety of autism models. He received an F31 NRSA predoctoral fellowship and is now an assistant professor at Augustana University.

Matthew J. Howard (2012-2014; M.A. Molecular Biology) Howard investigated synaptic pathways between cerebellum and nonmotor regions of forebrain. Now in financial services.

Benjamin Campbell (2011-2014; Rockefeller University) Campbell formulated theories of nonmotor function for cerebellum. Now working in Silicon Valley.

Thomas J. Pisano (2014-present; M.D.-Ph.D. program, Rutgers/Princeton) Pisano is tracing long-distance pathways linking the cerebellum with cognitive- and reward-related centers in the forebrain and basal ganglia. Funded by an F30 NRSA M.D.-Ph.D. fellowship award.

Ben Deverett (2014-present; M.D.-Ph.D. program, Rutgers/Princeton) Deverett is developing head-fixed virtual reality approaches to a working memory task in collaboration with the Tank laboratory. The long-term goal is to establish a preparation suitable for probing working memory mechanisms at a brain-wide level, including the cerebellum. Funded by an F31 NRSA M.D.-Ph.D. fellowship award.

INVITED SEMINARS

Invited scientific meetings

1997 Southern California Optical Biology Users Group, University of California, Irvine, CA.

2000 Neural Information and Coding Meeting, Grindelwald, *Switzerland*.

2001 Gordon Research Conference on Calcium Signaling, Oxford University, Oxford, *England*.

2002 Workshop on Single Cell Computation, University College London, London, *England*.

2003 Workshop on Constraints in Neural Systems Design, Computational Neuroscience (CNS 2003) Meeting, Alicante, *Spain*.

2003 Banbury Workshop, Optimization and Constraints in the Evolution of Brain Design, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

2003 Keck Foundation/National Academy of Sciences Futures Initiative, Decisions, Signals and Meaning in Biology, Chemistry, Physics and Engineering, Beckman Center, Irvine, CA. (no talk)

2004 Monte Verità Workshop on Spike-Timing Dependent Plasticity (STDP), Monte Verità, Ascona, *Switzerland*.

2004 Third Astrobiology Science Conference, NASA Ames Research Center, Moffett Field, CA.

2004 Symposium on Optical Methods in Neuroscience, Microscopy and Microanalysis meeting, Savannah, GA.

2004 Workshop on Optimization and Neural Coding, Institute for Theoretical Physics, Santa Barbara, CA.

2004 Meeting on Brain Development, National Alliance for Autism Research, Fort Lauderdale, FL. (no talk)

2005 Keck Foundation Annual Meeting, Los Angeles, CA. (also 2007, 2008, 2009, 2010)

2005 Invited retreat speaker, Department of Neurobiology, University of California, Los Angeles, CA.

2005 Mini-symposium on controlling neural function with light. Chair, Scott M. Thompson. Society for Neuroscience meeting, Washington, DC.

2005 Session moderator, Gordon Research Conference on Neuroethology. Chairs, Nicholas Strausfeld and Catherine Carr. Magdalen College, Oxford University, Oxford, *England*.

2005 US National Academy of Sciences Frontier of Science Symposium. Principles of Brain Design. Beckman Center, University of California, Irvine, CA.

2006 Rita Allen Foundation 30th Anniversary Symposium, Institute for Advanced Study, Princeton NJ.

2006 Human Frontier Science Project Awardees Annual Meeting, Institut Pasteur, Paris, *France*. (poster)

2007 Karger Workshop on brain evolution, Society for Neuroscience meeting, San Diego, CA.

2008 Mini-School and Workshop on Multiple Time Scales in the Dynamics of the Nervous System, Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, *Italy*.

2008 Conference on Perceptual Learning, Motor Learning, and Automaticity, Netherlands Institute for Neuroscience, Amsterdam, *Netherlands*. (commemoration of the 200th anniversary of the Royal Netherlands Academy of Sciences)

2009 Banbury meeting on Searching for Principles Underlying Memory in Biological Systems, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

2009 Meeting on Computational Cell Biology, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

2009 Psi Chi Invited Speaker, Midwestern Psychological Association meeting, Chicago, IL.

2009 Society for Research on the Cerebellum, second annual meeting, Chicago, IL.
2010 McGovern Institute for Brain Research Symposium: Cells, circuits & behavior, MIT, Cambridge, MA.
2010 Symposium on Photons and Neurons, University of Rochester, Rochester, NY.
2010 Symposium on in vivo cerebellar imaging, Federation of European Neuroscience Societies, Amsterdam, *Netherlands*.
2010 Barcelona Cognition, Brain and Technology summer school, Barcelona, *Spain*.
2011 W.M. Keck Foundation Scholars Program final meeting, Beckman Center, Irvine, CA (co-organizer).
2011 Gordon Research Conference on Dendrites, Ventura Marriott, Ventura, CA.
2011 First Gordon Research Conference on the Cerebellum, Colby-Sawyer College, New London, NH.
2011 Boston Club meeting on cerebellum and autism, Nancy Lurie Marks Fdn., Wellesley, MA.
2012 Conference, Dendrites: Substrates for Information Processing, Janelia Conference, Ashburn, VA.
2012 Eden Foundation 18th Annual Princeton Lecture Series (keynote address), Princeton, NJ.
2012 Conference, Fluorescent Proteins and Biological Sensors III, Janelia Conference, Ashburn, VA (attendance cancelled due to Hurricane Sandy).
2013 McKnight Foundation Annual Meeting, Aspen, CO.
2013 Annual research symposium (keynote speaker), Delaware chapter, Society for Neuroscience, Newark, DE.
2014 McKnight Foundation Annual Meeting, Aspen, CO.
2014 Conference, Fluorescent Proteins and Biological Sensors IV, Janelia Conference, Ashburn, VA.
2014 Society for Neuroscience nanosymposium on cerebellum and autism (speaker and chair), Washington, DC.
2015 Keystone Conference on Pathways of Neurodevelopmental Disorders, Tahoe City, CA.
2015 BRAIN Initiative Investigator meeting, Bethesda, MD.
2016 McKnight Foundation Annual Meeting, Minneapolis, MN.
2016 Course on mouse methods in neuroscience, Jackson Laboratory, Bar Harbor, ME.
2017 Conference on cognition and psychiatric diseases, Brain and Spine Institute, Paris, *France*.
2017 Conference on procedural learning, Amsterdam, *Netherlands*.
2017 Gordon Research Conference on the Cerebellum, Bates College, Lewiston, ME.
2018 FENS Forum on the cognitive cerebellum, organized by M.E. Goldberg. Berlin, *Germany*.

Invited talks (Research departments)

1994 Department of Physiology, University of Colorado Health Sciences Center, Denver, CO.
1995 Department of Theoretical Physics, AT&T Bell Laboratories, Murray Hill, NJ.

1995 Laboratory of Theoretical and Physical Biology, National Institutes of Health, Bethesda, MD.

1999 Department of Neurobiology, Duke University Medical Center, Durham, NC.

1999 Department of Biomedical Engineering, Boston University, Boston, MA.

1999 Department of Developmental and Cell Biology, University of California, Irvine, CA.

1999 Department of Molecular Biology, Princeton University, Princeton, NJ.

1999 Department of Neurobiology and Behavior, University of California, Irvine, CA.

2000 Department of Neurology, Stanford University Medical Center, Stanford, CA.

2000 Department of Physiology, University College, London, *England*.

2000 Division of Neurophysiology, National Institute for Medical Research, London, *England*.

2000 Department of Biology, Morehouse College, Atlanta, GA.

2000 Max Planck Institute for Medical Research, Dept. Biomedical Optics, Heidelberg, *Germany*.

2000 Karolinska Institutet, Stockholm, *Sweden*.

2001 Sloan Center for Theoretical Neurobiology, Caltech, Pasadena, CA.

2001 Program in Neuroscience, Columbia University, New York, NY.

2001 Wyeth-Ayerst Research Laboratories, Princeton, NJ.

2002 Center for Neurobiology, Mount Sinai School of Medicine, New York, NY.

2002 Systems neuroscience seminar, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

2002 Department of Physiology, New York Medical College, Albany, NY.

2003 Department of Physiology and Biophysics, University of Washington, Seattle, WA.

2003 Center for Cognitive Neuroscience, Duke University, Durham, NC.

2004 Baylor Medical College, Houston, TX. (Distinguished Neuroscientist Lecture Series)

2004 Max Planck Institute for Medical Research, Dept. Cell Physiology, Heidelberg, *Germany*.

2004 University of California, San Diego, CA.

2004 Salk Institute for Biological Studies, La Jolla, CA.

2004 Mathematical Biosciences Institute, Ohio State University, Columbus, OH.

2004 Neuroscience Program, University of Michigan, Ann Arbor, MI.

2004 Rowland Institute for Physics, Harvard University, Cambridge, MA.

2004 Department of Molecular and Cell Biology, Harvard University, Cambridge, MA.

2005 Center for Statistics in the Social Sciences, University of Washington, Seattle, WA.

2005 Department of Physiology and Biophysics, University of Washington, Seattle, WA.

2005 Department of Brain and Cognitive Sciences, MIT, Cambridge, MA.

2005 Learning and Memory Seminar, Dept. Neurobiology, University of California, Los Angeles, CA.

2005 Redwood Neuroscience Institute, Menlo Park, CA.

2005 Department of Neurobiology, Stanford University School of Medicine, Stanford, CA.

2005 Hopkins Marine Station, Stanford University, Pacific Grove, CA.

2005 Neuroscience Colloquium, Brown University, Providence, RI.

2005 CIMA, University of Navarra, Pamplona, *Spain*.

2006 Biological Chemistry Seminar Series, University of Pennsylvania, Philadelphia, PA.

2006 Vollum Institute, Oregon Health Sciences University, Portland, OR.

2006 Interdepartmental science seminar series, Delaware State University, Dover, DE.

2006 Department of Physiology, Anatomy and Genetics, Oxford University, Oxford, *England*.

2006 Instituto de Neurociencias de Alicante, Universidad Miguel Hernandez, Alicante, *Spain*.

2006 Max Planck Institute for Medical Research, Dept. Cell Physiology, Heidelberg, *Germany*.

2006 Mahoney Institute of Neurological Sciences colloquium, Univ. Pennsylvania, Philadelphia, PA.

2006 Translational Neuroscience Seminar Series, Mount Sinai School of Medicine, New York, NY.

2007 Neuroscience program, University of California San Diego, San Diego, CA.

2007 Biophysics seminar series, Rockefeller University, New York, NY.

2007 Keynote speaker, Robert Wood Johnson MD/PhD program retreat, UMDNJ, Piscataway, NJ.

2007 Seminars in Neuroscience series, West Virginia University, Morgantown, WV.

2008 Janelia Farm, Howard Hughes Medical Institute, Ashburn, VA.

2008 Department of Physiology, University College, London, *England*.

2009 Origins Institute, McMaster University, Toronto, *Canada*.

2009 Neuroscience Graduate Program seminar, McMaster University, Toronto, *Canada*.

2009 SUNY Downstate Medical Center, Brooklyn, NY.

2009 Department of Neuroscience, Johns Hopkins University School of Medicine, Baltimore, MD.

2010 Department of Neurobiology, University of Chicago, Chicago, IL.

2011 University of Paris Descartes, Paris, *France*.

2011 Department of Neurology, University of Texas Southwestern Medical Center, Dallas, TX.

2011 University of Southern California, Los Angeles, CA.

2012 Google Research, Mountain View, CA.

2012 Hopkins Marine Station, Stanford University, Pacific Grove, CA.

2012 Seaver Autism Research Center, Mount Sinai School of Medicine, New York, NY.

2013 Dept. Neuroscience, Robert Wood Johnson Medical School, UMDNJ, Piscataway, NJ.

2013 Physics colloquium, Rutgers University, New Brunswick, NJ.

2014 Department of Neurology, University of California Los Angeles, Los Angeles, CA.

2014 Dept. Biochemistry and Molecular Medicine, George Washington University, Washington, DC.

2014 Neuroscience seminar series, Indiana University, Bloomington, IN.

2014 Progress in Neuroscience series, Brain and Mind Research Institute, Weill Cornell Medical College, New York, NY.

2015 Neuroscience and Medicine series, Department of Neuroscience, Pasteur Institute, Paris, *France*.

2015 Department of Biology, University of South Carolina, Columbia, SC.

2015 Okinawa Institute of Science and Technology, Okinawa, *Japan*. (visit postponed)

2016 Department of Neuroscience, Thomas Jefferson University, Philadelphia, PA.

- 2016 Symposium on the cerebellum and autism, Sick Kids Hospital, Toronto, *Canada* (keynote).
- 2017 Max Planck Institute, Jupiter, FL.
- 2017 Center for Computational Cognitive Neuropsychiatry, Rutgers University, New Brunswick, NJ.
- 2017 Department of Neurobiology, Duke University, Durham, NC.
- 2017 Brain Talk, Roche Pharmaceutical, Basel, Switzerland.
- 2017 Kavli Brain Forum, Emory University, Atlanta, GA.
- 2017 Biophysics Colloquium, Cornell University, Ithaca, NY.
- 2017 Rockefeller University, New York, NY.
- 2018 Children's National Hospital, Washington, DC.
- 2019 Neurology Grand Rounds, UCLA, Los Angeles, CA.

Invited public talks

- 1997 National Association of Graduate-Professional Students, 12th annual meeting, New Orleans, LA.
- 2001 World Congress of Science Producers, Washington, DC.
- 2002 Policy Fellows' retreat, American Association for the Advancement of Science, Washington DC.
- 2002 Science on Saturdays lecture, Princeton Plasma Physics Laboratory, Princeton, NJ.
- 2004 Phi Beta Kappa induction dinner, Princeton University.
- 2005 Nassau Club, Princeton, NJ.
- 2005 Discussion panelist. Blurry vision: bridging the gap between science and the public. Princeton Dept. Molecular Biology and New York Academy of Sciences meeting. November 8, 2005.
- 2006 Princeton Alumni Council outreach trip, Seattle, WA.
- 2006 Princeton Tiger Talk for high school students, Princeton, NJ.
- 2007 Discussant, panel on career development, Society for Neuroscience, San Diego, CA.
- 2007 Princeton Alumni Council outreach trip, Los Angeles, CA.
- 2008 Smithsonian Associates, Washington, DC.
- 2008 Princeton Alumni Council outreach trip, Hong Kong, China.
- 2008 Brainwave series, discussion of creativity and the brain with Sandra Aamodt and director Julie Taymor, Rubin Museum of Art, New York, NY.
- 2008 authors@google, Mountain View, CA.
- 2008 Panel discussion on science writing: "Crystals, Quarks, Biomes and Genomes: How to Make Complex Science Compelling." Princeton University, Princeton, NJ.
- 2008 Conference on Learning and the Brain, MIT, Cambridge, MA.
- 2008 Panel discussion on the Challenges of the Brain, sponsored by *Discover* magazine/NSF/Franklin Institute. Philadelphia, PA.
- 2008 Renaissance Weekend, Charleston, SC.
- 2009 Princeton Regional Chamber of Commerce, Princeton, NJ.
- 2009 Brainwave series, discussion of science and Buddhism with Donald S. Lopez Jr., Rubin Museum of Art, New York, NY.

2009 Adventures of the Mind mentoring summit, Institute for Advanced Study, Princeton, NJ.

2009 TEDxSF talk, San Francisco, CA. www.tedxsf.org.

2010 Speaker, freshman address, Princeton University.

2011 Annual David Wilkinson Lecture, Harold R. Medina Seminar for State and Federal Judges, Princeton, NJ.

2011 Adventures of the Mind mentoring summit, Missoula, MT.

2012 Conference on Learning and the Brain (keynote address), Columbia University, New York, NY.

2012 Annual David Wilkinson Lecture, Harold R. Medina Seminar for State and Federal Judges, Princeton, NJ.

2012 Common Ground (local K-12 schools consortium), Princeton, NJ.

2013 Parents and Science lecture series, Rockefeller University, New York, NY.

2013 Riverside Elementary School, Princeton, NJ.

2013 Annual David Wilkinson Lecture, Harold R. Medina Seminar for State and Federal Judges, Princeton, NJ.

2013 AAAS Science and Technology Fellowship Year-End Summit, Silver Spring, MD.

2013 Conference on Active, Engaged Minds (Learning And the Brain), Boston, MA.

2014 The Science Behind The Science Behind The News, discussion of neuroscience with Joe Palca, Smithsonian Institution, Washington, DC.

2014 Understanding Autism, SciCafe, American Museum of Natural History, New York, NY.

2014 Invited panelist, Society for Neuroscience Professional Development Workshop on Teaching Neuroscience.

2016 Annual David Wilkinson Lecture, Harold R. Medina Seminar for State and Federal Judges, Princeton, NJ.

2016 Partnership for Maternal and Child Health of Northern New Jersey - annual meeting, Newark, NJ.

2017 Grand Rounds, Princeton House, Princeton, NJ.

2018 Science on Saturdays lecture, Princeton Plasma Physics Laboratory, Princeton, NJ.

2018 Paul D. Bartlett Lecture at the Linda Hall Science and Technology Library, Kansas City, MO.

Teaching at Princeton (* = new course; see also Policy and Legislative Work)

F2000-01 *MOL 508 - Neurobiology (with Berry, Tsien in different years)

F2001-06, 2008 *MOL 408 - Neurobiology (with Berry, Gould, Eggenschwiler, Haxby in different years)

S2002 *MOL 549 - Laboratory in Neurophysiology (with Gelperin/Tank)

F2006 *MOL 90 - Advanced Seminar in Cellular and Systems Neuroscience

S2009-10 MOL 214 - Introduction to Cellular and Molecular Biology (co-instructor)

F2009-16 *NEU501 - Neuroscience Ph.D. core course (co-instructor)

S2010-14 *NEU101 - Neuroscience and Everyday Life (with Gelperin)

S2012-13, 2015 *MOL451 - Genes, Brain, and the Human Mind (with Rosenberg 2012-13)

F2017, 2018 NEU501A-MOL501A – Neuroscience Ph.D. core course (course organizer)

External teaching activities

Mar.-Apr. 2008 *Workshop co-organizer, Kavli Institute for Theoretical Physics. Program on Anatomy, Development, and Evolution of the Brain.*

Summer 2012-13 *Invited lecturer, summer course, Biophysics and Computation in Neurons and Networks. Organized by Alan Gelperin, David Tank, and Michael Berry.*

Summer 2015-17 *Invited lecturer, summer course, Neurotechnologies for Analysis of Network Dynamics (NAND). Organized by Gelperin, Tank, and Berry.*

Summer 2018 *Invited lecturer, summer course, Cellular, Cognitive, and Computational Neuroscience (C3N). Organized by Gelperin, Tank, and Berry.*