Samuel J. Sober, Ph.D.

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Positions and Research Experience

Emory University ..... Atlanta, GA
Associate Professor of Biology 9/17-present

Emory University ..... Atlanta, GA
Assistant Professor of Biology 9/10-8/17

University of California, San Francisco ..... San Francisco, CA
Postdoctoral Fellow 4/05-8/10
Advisor: Dr. Michael S. Brainard
Postdoctoral research on the physiology of motor control and motor learning in songbirds.

University of California, San Francisco ..... San Francisco, CA
Graduate Student 9/99-2/05
Advisor: Dr. Philip N. Sabes
Doctoral research on the psychophysics of motor planning and multisensory integration.

University of Wisconsin - Madison ..... Madison, WI
Undergraduate Research Assistant 6/96-8/96
Advisors: Drs. William W. Lytton and Dwayne S. Yamasaki 6/97-5/98
Designed and programmed simulations of the effects of cortical lesions on the information-processing properties of surviving neurons.

Education

University of California, San Francisco ..... San Francisco, CA
Graduate Program in Neuroscience 9/99-2/05
Doctoral thesis research on human motor planning and sensory integration.

Marine Biological Laboratories ..... Woods Hole, MA
Methods in Computational Neuroscience 8/04
Intensive summer course.

Kyunghee University ..... Seoul, South Korea
Henry Luce Visiting Scholar 9/98-6/99
Independent study on the clinical practice and physiological bases of acupuncture.

Wesleyan University ..... Middletown, CT
B.A., Neuroscience & Behavior 9/94-6/98

Honors

McKnight Foundation Award for Technological Innovations in Neuroscience 2018
Graduates in Neuroscience Faculty Mentor Award 2018
Awarded by the students in Emory's Neuroscience Graduate Program in recognition of outstanding mentoring of trainees.
Albert E. Levy Scientific Research Award 2017
Awarded to recognize the contributions of Emory faculty members to the advancement of scientific knowledge.
Graduates in Neuroscience Exemplary Lecturer Award 2016
Awarded by the students in Emory's Neuroscience Graduate Program in recognition of outstanding teaching contributions.
COSYNE Mentorship Award 2014
Awarded by the COSYNE meeting to recognize a faculty member's outstanding mentorship of a student from an underrepresented group.
Helen Hay Whitney Foundation Postdoctoral Research Fellowship 2006-2009
NSF Graduate Research Fellowship 1999-2002
Henry Luce East Asian Scholar 1998-1999

Current Grant Support

National Institutes of Health Grant R01 NS099375 . . . . . 3/2017-2/2022
Spike timing codes for motor control
Role: PI
Direct cost: $1,134,500 Total cost: $1,660,500

The goal of this work is to understand how the nervous system controls behavior by precisely regulating the timing of electrical activity in neurons and muscles.

National Institutes of Health Grant R01 NS084844 . . . . . 3/2013-2/2019
Vocal motor control and sensorimotor learning - behavior, muscles, and neurons
Role: PI
Direct cost: $1,128,829 Total cost: $1,626,442 (Currently in no-cost extension)

The goal of this study is to understand how patterns of neural activity and muscle activation are reshaped during vocal learning.

National Institutes of Health Grant R01 EB022872 . . . . . 9/2016-6/2019
Neural mechanisms and behavioral consequences of non-Gaussian likelihoods in sensorimotor learning
Role: PI (multi-PI grant with Dr. Ilya Nemenman)
Direct cost: $675,000 Total cost: $1,034,495

The goal of this work (supported by the federal BRAIN initiative) is to develop new experimental and analytical methods for revealing how the brain implements complex computations.

National Institutes of Health Grant R01 NS109237 . . . . . 6/2019-6/2024
Large-scale recording of spike train ensembles from muscle fibers during skilled behavior in mice and songbirds
Role: PI (multi-PI grant with Dr. Muhannad Bakir)
Direct cost: $1,917,500 Total cost: $2,458,355

The goal of this project is to develop novel hardware and algorithms to record ensembles of motor units in two model systems - vocal performance in songbirds and skilled forelimb behavior in mice.

NSF Grant 1822677 . . . . . 9/2018-8/2022
CRCNS: Randomness and systematicity in neural codes for motor exploration
Role: PI (multi-PI grant with Dr. Ilya Nemenman)
Direct cost: $661,147 Total cost: $1,000,000

The goal of this project is to understand how the nervous systems generates behavioral variability.

Completed Grant Support

NSF Grant 1456912 ..... 5/2015-4/2018
The neural basis of online error correction
Role: PI
Direct cost: $331,379 Total cost: $510,000

The goal of this study is to understand how the brain rapidly integrates sensory information to correct motor errors online.

Udall Parkinson's Disease Research Center Pilot Grant 4/2013-3/2014
The songbird as a novel model of Parkinsonian deficits in motor control and sensorimotor learning
Role: PI
Direct cost: $30,000 Total cost: $30,000

The goal of this study (funded by the Udall Centers of Excellence for Parkinson's Disease Research) was to develop the songbird as an accessible animal model for the deficits in vocal production and sensorimotor learning observed in Parkinson's disease.

National Institutes of Health Grant 5P30NS069250 ..... 9/2010-8/2012
Recovery Act Limited Competition: Supporting New Faculty Recruitment to Enhance Systems and Computational Neuroscience at Emory University
Role: New Faculty Member
Direct cost: $1,000,000 Total cost: $1,127,050

This P30 grant was obtained (by PI Dr. Ron Calabrese) for the purposes of recruiting a systems and computational neuroscientist to Emory's Biology Department, equipping the laboratory, paying salaries to lab members, and funding preliminary work necessary to compete for extramural support.

Grant Support Awarded to Trainees in my Group

National Institutes of Health Grant F31NS100406 ..... 9/2017-8/2019
Establishing the role of dopamine in Vocal Learning in Songbirds
Role: Faculty Advisor (PI is Varun Saravanan, a graduate student in my lab)
Direct cost: $87,152 Total cost: $87,152

National Science Foundation GRFP DGE-1444932 ..... 6/2017-5/2020
Precise spike-timing codes for motor control
Role: Faculty Advisor (PI is Andrea Pack, a graduate student in my lab)
Direct cost: $104,000 Total cost: $104,000

National Science Foundation GRFP DGE-1444932 ..... 6/2016-5/2019
Dopaminergic contributions to vocal learning in the basal ganglia
Role: Faculty Advisor (PI is Alynda Wood, a graduate student in my lab)
Direct cost: $102,000 Total cost: $102,000

National Institutes of Health Grant F31 DC013753 ..... 3/2014-2/2017
Defining the Neuromuscular Mechanisms of Vocal Error Correction
Role: Faculty Advisor (PI was Kyle Srivastava, a graduate student in my lab)
Direct cost: $126,696 Total cost: $126,696

Grant Support Awarded to Trainees in my Group, continued

National Institutes of Health Grant F31 NS089406 ..... 9/2014-8/2016
Dissecting the basal ganglia's contribution to sensorimotor learning and generalization
Role: Faculty Advisor (PI was Lukas Hoffmann, a graduate student in my lab)
Direct cost: $85,352 Total cost: $85,352

Peer-Reviewed Publications

* Equal contributions

Daliparthi VK, Tachibana RO, Cooper BG, Hahnloser RH, Kojima S, **Sober SJ**, Roberts TF (2019). Transitioning between preparatory and precisely sequenced neuronal activity in production of a skilled behavior. *eLife* 11;8.

Saravanan V, Hoffmann LA, Jacob AL, Berman GJ, **Sober SJ** (2019). Dopamine Depletion Affects Vocal Acoustics and Disrupts Sensorimotor Adaptation in Songbirds. *eNeuro* 6(3).

Zhou B, Hofmann D, Pinkoviezky I, **Sober SJ**, Nemenman I (2018). Chance, long tails, and inference in a non-Gaussian, Bayesian theory of vocal learning in songbirds. *Proceedings of the National Academy of Sciences* Sep 4;115(36):E8538-E8546.

Nicholson DA, Roberts T, and **Sober SJ** (2018). Thalamostriatal and cerebellothalamic pathways in a songbird, the Bengalese finch. *Journal of Comparative Neurology* doi: 10.1002/cne.24428.

Zia M, Chung B, **Sober SJ**, and Bakir M (2018). Fabrication and Characterization of 3D Multi-Electrode Array on Flexible Substrate for In Vivo EMG Recording from Expiratory Muscle of Songbird. *Proc. IEEE International Electron Devices Meeting (IEDM)* San Francisco, CA, Dec. 2018.

Srivastava K*, Holmes CM*, Vellema M, Pack A, Elemans C, Nemenman I, and **Sober SJ** (2017). Motor control by precisely timed spike patterns. *Proceedings of the National Academy of Sciences* 114(5):1171-1176.

Wyatt M, Berthiaume E, and **Sober SJ** (2017). The Effects of Pitch Shifts on Delay-induced Changes in Vocal Sequencing in a Songbird. *eNeuro* doi: 10.1523/ENEURO.0254-16.2017.

Hoffmann LA, Saravanan V, Wood AN, and **Sober SJ** (2016). Dopaminergic Contributions to Vocal Learning. *J. Neuroscience* 36(7): 2176-89.

Elemans CP, During DN, Herbst CT, Rasmussen JH, Zollinger SA, Brumm H, Srivastava K, Svane N, Ding M, Larsen ON, **Sober SJ**, and Svec JG (2015). Universal mechanisms of sound production and control in birds and mammals. *Nature Communications* 6:8978:1-13.

> My group developed, implemented, and analyzed data from a key experimental technique for this study (electrical muscle stimulation during *in vitro* high-speed imaging of the intact vocal organ).

Srivastava K, Elemans C, and **Sober SJ** (2015). Multifunctional and context-dependent control of vocal acoustics by individual muscles. *J. Neuroscience* 35(42):14183-94.

Tang C, Srivastava K, Chehayeb D, Nemenman I, and **Sober SJ** (2014). Precise temporal encoding in a vocal motor system. *PLoS Biology* 12(12):e1002018:1-13.

> The above paper was featured with a cover image and synopsis in *PLoS Biology* and was selected as a "Research Highlight" by *Nature Reviews Neuroscience* (15 January 2015).

Hoffmann LA and **Sober SJ** (2014). Vocal generalization depends on gesture identity and sequence. *J. Neuroscience*. 34(16):5564-74

Peer-Reviewed Publications (continued)

Kelly CW and **Sober SJ** (2014). A simple computational principle predicts vocal adaptation dynamics across age and error size. *Front. Integr. Neurosci.*. 8:75:1-9

Hoffmann LA, Kelly CW, Nicholson DA, and **Sober SJ** (2012). A lightweight, headphones-based system for manipulating auditory feedback in songbirds. *J. Visualized Experiments*. (69):1-9

Sober SJ and Brainard MS (2012). Vocal learning is constrained by the statistics of sensorimotor experience. *Proceedings of the National Academy of Sciences*. 109(51):21099-103

Wohlgemuth MJ*, **Sober SJ***, and Brainard MS (2010). Linked Control of Syllable Sequence and Phonology in Birdsong. *J. Neuroscience* 30(39):12936-49.

Sober SJ and Brainard MS (2009). Adult birdsong is actively maintained by error correction. *Nature Neuroscience* 12(7):927-31.

Sober SJ*, Wohlgemuth MJ*, and Brainard MS (2008). Central Contributions to Acoustic Variation in Birdsong. *J. Neuroscience*, 28(41):10370-9.

Sober SJ and Sabes PN (2005). Flexible Strategies for Sensory Integration during Motor Planning. *Nature Neuroscience*, 8(4):490-7.

Sober SJ and Sabes PN (2003). Multisensory Integration During Motor Planning. *J. Neuroscience* 23(18):6982-92.

Lytton WW, Williams ST, **Sober SJ** (1999). Unmasking unmasked: Neural dynamics following stroke. *Progress In Brain Research* 121:203-218.

Lytton WW; Stark JM; Yamasaki DS; **Sober, SJ** (1999). Computer models of stroke recovery: Implications for neurorehabilitation. *The Neuroscientist* 5:100-111.

Sober SJ; Stark JM; Yamasaki DS; Lytton WW (1997). Receptive field changes following stroke-like cortical ablation: a role for activation dynamics. *J. Neurophysiology* 78:3438-3443.

Publications: Reviews and Invited Commentaries

Sober SJ, Sponberg S, Nemenman I, Ting LH (2018). Millisecond Spike Timing Codes for Motor Control. *Trends in Neurosciences* 41(10):644-648.

> This invited review article was part of a special combined issue of *Trends in Neurosciences* and *Trends in Cognitive Sciences* exploring "Time in the Nervous System."

Kuebrich B and **Sober SJ** (2015). Variations on a theme: songbirds, variability, and sensorimotor error correction. *Neuroscience* 296:48-54.

> This invited review article was part of a special issue of *Neuroscience* highlighting the contributions of different animal model systems to the field of neurobiology.

Sober SJ and Calabrese RL (2014). Falling on deaf neurons. *eLife*. 3:e02289

Sober SJ and Kording K (2012). What silly postures tell us about the brain. *Frontiers in Neuroscience*. 6:154

Ph.D. Students Supervised:

Kyle Srivastava (2010-2016)
Ph.D. conferred 5/6/2016. Dissertation: "Defining the Neuromuscular Mechanisms of Vocal Motor Control".
Dr. Srivastava is now a Senior R&D Engineer at Boston Scientific (Minneapolis-St. Paul, MN).

Lukas Hoffmann (2011 - 2017)
Ph.D. conferred 4/18/2017. Dissertation: "Complex sensorimotor processing and neural plasticity in the Bengalese finch song system during vocal learning and error correction".
Dr. Hoffmann is now a Software Engineer at Micrometrics (Atlanta, GA).

David Nicholson (2011 - 2018)
Ph.D. conferred 9/18/2017. Dissertation: "Cerebellothalamic and thalamostriatal projections in a songbird, the Bengalese Finch".
Dr. Nicholson is currently a postdoctoral fellow jointly advised by Constantine Dovrolis (Georgia Tech) and Astrid Prinz (Emory).

Varun Saravanan	(2014 - present)	**Rachel Barker**	(Fall 2017 - Rotation)
Alynda Wood	(2015 - present)	**Ben Kuebrich**	(Spring 2014 - Rotation)
James McGregor	(2016 - present)	**Seth Koenig**	(Spring 2012) - Rotation)
Andrea Pack	(2016 - present)		
Sena Agezo	(Fall 2017 - Rotation)		

Undergraduate Students Supervised:

Claire Tang Fall 2012 - Spring 2013 Publication: Tang et al. (*PLoS Biology*, 2014)
Claire is currently a PhD student in Neuroscience at the University of California, San Francisco

Caroline Holmes Fall 2015 - Spring 2017 Publication: Srivastava et al. (*PNAS*, 2017)
Caroline is currently a PhD student in Physics at Princeton University

MacKenzie Wyatt Fall 2013 - Spring 2016 Honors Thesis, received Highest Honors
Publication: Wyatt et al. (*eNeuro*, 2017)
Mackenzie is currently a second-year medical student at the University of Kentucky

Emily Berthiaume Spring 2013 - Spring 2014 Honors Thesis; received Highest Honors
Publication: Wyatt et al. (*eNeuro*, 2017)
Emily is currently a third-year medical student at UCLA

Conor Kelly Spring 2011-Fall 2012 Publication: Kelly & Sober (*Frontiers*, 2014)
Conor is currently a third-year medical student at Georgia Regents University

Benjamin Bolte Spring 2014 - Spring 2015
Benjamin is currently a Software Engineer at Facebook

Umar Khan	Spring 2017	**Rana Alsiro**	Fall 2011- Spring 2012
Eli Patt	Fall 2015 - Fall 2016	**Je Eun Park**	Fall 2011- Spring 2012
Jonah Queen	Spring 2013	**Jeffrey Simpson**	Spring 2011 - Fall 2011
Carolyn Mclaughlin	Spring 2013		
Sevara Rakhimova	Spring 2013 - Fall 2013		

Invited Seminars and Platform Presentations (since 2010)

Sober SJ *Neural, muscular, and computational mechanisms of vocal control.* Burke Neurological Institute/Weill Cornell Medicine, White Plains, NY, March 19, 2019 (Invited seminar).

Sober SJ *Neural and Computational Mechanisms of Vocal Control.* University of Texas, Southwestern, January 29, 2019 (Invited seminar).

Sober SJ *Dopaminergic Signals for Vocal Learning in Songbirds.* Federation of European Neuroscience Unions (FENS) meeting, Berlin, Germany, July 8, 2018 (Invited speaker).

Sober SJ *Neural and Computational Mechanisms of Vocal Control.* Aspen Center for Physics, Aspen, CO, June 4, 2018 (Invited speaker and participant, Aspen Center for Physics Summer Workshop).

Sober SJ *Sensorimotor learning and the dynamics of birdsong.* University of Southern California, October 5, 2018 (Invited speaker, Hearing and Communication Neuroscience Symposium).

Sober SJ *Spike timing codes for skilled motor control.* The Banbury Center, Cold Spring Harbor Laboratory, Lloyd Harbor, NY, September 24, 2018 (Invited speaker, Quantitative Approaches to Naturalistic Behaviors Meeting).

Sober SJ *Spike timing codes for dexterous motor control.* Janelia Research Campus, Ashburn, VA, May 14, 2018 (Invited speaker, Mechanisms of Dexterous Behavior symposium).

Sober SJ *Spike timing codes for skilled motor control.* NIH BRAIN Investigators Meeting, Bethesda, MD, April 11, 2018 (Invited speaker, Research Highlight talk).

Sober SJ *Advanced technologies for monitoring and manipulating muscle activity during skilled behavior.* Rice University, Houston, TX, February 7, 2018 (Invited seminar).

Sober SJ *Vocal control, sensorimotor learning, and the dynamics of birdsong.* International Bioacoustics Council, XXVI IBAC Congress, Haridwar, India, October 10, 2017 (Platform presentation).

Sober SJ *Vocal motor control and sensorimotor learning: behavior, neurophysiology, and biomechanics.* Indian Institute of Science Education and Research, Pune, India, October 6, 2017 (Invited seminar).

Sober SJ *Spike timing codes for motor control.* Computational and Systems Neuroscience (COSYNE) meeting; Salt Lake City, Utah, February 28, 2017 (Platform presentation).

Sober SJ *Vocal motor control and sensorimotor learning: behavior, neurophysiology, and biomechanics.* Georgia Institute of Technology, Altanta, GA, February 21, 2017 (Invited seminar).

Sober SJ *Sensorimotor learning and the dynamics of birdsong.* University of California Berkeley, January 23, 2017 (Invited seminar).

Sober SJ *Sensorimotor learning and the dynamics of birdsong.* University of Washington, Seattle, WA, October 28, 2016 (Invited seminar).

Sober SJ *Vocal motor control and sensorimotor learning: behavior, neurophysiology, and biomechanics.* University of Washington, Seattle, WA, October 27, 2016 (Invited seminar).

Sober SJ *Nonlinear Bayesian computations for vocal learning.* Computational and Systems Neuroscience Workshop, Salt Lake City, UT, February 29, 2016 (Platform presentation).

Sober SJ *Flexible strategies for sensory integration during motor planning.* Institut de Neurosciences de la Timone, Marseille, France, January 28, 2016 (Platform presentation).

Sober SJ *Vocal control, sensorimotor learning, and the dynamics of birdsong.* Hunter College, City University of New York, October 8, 2015 (Invited seminar).

Sober SJ *Neural and computational mechanisms of vocal control.* Cold Spring Harbor Laboratories, Cold Spring Harbor, NY, October 7, 2015 (Invited seminar).

Invited Seminars and Platform Presentations (continued)

Sober SJ *Neural and computational mechanisms of vocal control.* New York University, New York City, October 6, 2015 (Invited seminar).

Sober SJ *Vocal variability: Computational consequences and neurophysiological substrates.* CNS Satellite Symposium: Neural bases of speech production, San Francisco, CA, March 27, 2015 (Platform presentation).

Sober SJ *Dopaminergic contributions to vocal learning.* University of California, San Francisco, March 26, 2015 (Invited seminar).

Sober SJ *Behavioral, neural, and biomechanical approaches to vocal control.* University of California, Berkeley, March 25, 2015 (Invited seminar).

Sober SJ *Vocal control, sensorimotor learning, and the dynamics of birdsong.* Cornell University, Ithaca, NY, February 27, 2015 (Invited seminar).

Sober SJ *Millisecond-scale neural encoding in a vocal motor system.* Society for Neuroscience Satellite Symposium on Vocal Communication, Washington, DC, November 14, 2014 (Platform presentation).

Sober SJ *Behavioral, neural, and biomechanical approaches to vocal control.* University of Texas, San Antonio, October 2, 2014 (Invited seminar).

Sober SJ, Tang C, Srivastava K, Chehayeb D, Nemenman I *Precise temporal encoding in a vocal motor system.* Annual Meeting, Society for the Neural Control of Movement; Amsterdam, The Netherlands, April 25, 2014. (Platform presentation)

Sober SJ *Behavioral, neural, and biomechanical approaches to vocal control.* CNRS, Universite Rene Descartes; Paris, France, April 18, 2014 (Invited seminar).

Sober SJ *Vocal control, sensorimotor learning, and the dynamics of birdsong.* Pennsylvania State University; State College, PA, Feb 7, 2014 (Invited seminar).

Sober SJ *Behavioral and biomechanical approaches to vocal control.* Northwestern University; Rehabilitation Institute of Chicago, Chicago, IL, April 12, 2013 (Invited seminar).

Sober SJ *Neural, behavioral, and computational approaches to vocal learning.* Neuroscience and Behavior Colloquium Series: Emory University Psychology Department, December 19, 2013 (Invited seminar).

Sober SJ *Behavioral and biomechanical approaches to sensorimotor control.* Georgia Institute of Technology, Atlanta, GA, April 3, 2013 (Invited seminar).

Sober SJ *Behavioral and biomechanical approaches to birdsong.* Tulane University, New Orleans, LA, March 18, 2013 (Invited seminar).

Sober SJ *Mathematical and physiological approaches to vocal learning.* Cognition and Development Colloquium Series: Emory University Psychology Department, October 9, 2012 (Invited seminar).

Sober SJ *Neural and computational approaches to sensorimotor learning.* Florida State University, Tallahassee, FL, April 4, 2012 (Invited seminar).

Sober SJ *Neurons, muscles, and the dynamics of vocal learning.* Society for Neuroscience Satellite Symposium on Vocal Communication, Washington, DC, November 11, 2011 (Platform presentation).

Sober SJ *Vocal control, sensorimotor learning, and the dynamics of birdsong.* University of Southern California, Los Angeles, CA, October 24, 2011 (Invited seminar).

Sober SJ *Learning within statistical and biomechanical constraints - lessons from birdsong.* Georgia State University, Atlanta, GA (Invited seminar), May 3, 2011.

Sober SJ *Songbirds as a model system for vocal behavior.* American Association of Laboratory Animal Science Animal Meeting, Atlanta, GA, October 13, 2010 (Invited seminar).

Sober SJ *The neural and muscular basis of vocal learning.* Frontiers in Neuroscience Seminar, Emory University, Atlanta, GA, September 24, 2010 (Invited seminar).

Sober SJ *Physiological and computational approaches to vocal motor plasticity.* Champalimaud Institute for the Unknown, Lisbon, Portugal, April 12, 2010 (Invited seminar).

Sober SJ *Vocal learning and the dynamics of birdsong.* Emory University, Atlanta, GA, February 12, 2010 (Invited seminar).

Sober SJ *Motor control, sensorimotor learning, and the dynamics of birdsong.* McGill University, Montreal, Quebec, February 1, 2010 (Invited seminar).

Contributed Presentations (since starting at Emory in 2010)

Wood AN, Hoffmann LA, Jacob AL, Saravanan V, and **Sober SJ** (2018). Dopaminergic contributions to vocal learning. *Gordon Conference on the Basal Ganglia* (Poster - **won best poster award**).

Saravanan V, Hoffmann LA, Jacob AL, and **Sober SJ** (2017). The role of dopamine in sensorimotor adaptation in songbirds. *Annual Meeting, Society for Neuroscience* (Poster).

Jacob AL, Wood AN, and **Sober SJ** (2017). Dopaminergic input to Bengalese finch song system nuclei. *Annual Meeting, Society for Neuroscience* (Poster).

Nicholson DA, Roberts TF, and **Sober SJ** (2017). Cerebellothalamic and thalamostriatal projections in a songbird. *Annual Meeting, Society for Neuroscience* (Poster).

McGregor JN, Jaffe PI, Brainard MS, and **Sober SJ** (2017). Somatosensory-driven vocal learning in adult songbirds. *Annual Meeting, Society for Neuroscience* (Poster).

Zhou B, Hofman D, **Sober SJ**, and Nemenman I (2017). Dynamics of Bayesian non-Gaussian sensorimotor learning with multiple time scales. *Annual Meeting, American Physical Society* (Talk).

Lahme D, **Sober SJ**, and Nemenman I (2017). Bayesian Ising approximation for learning dictionaries of multispike timing patterns in premotor neurons. *Annual Meeting, American Physical Society* (Talk).

Holmes C, Srivastava K, Vellema M, Elemans C, Nemenman I,, and **Sober SJ** (2016). Songbird Respiration is Controlled by Multispike Patterns at Millisecond Temporal Resolution. *Annual Meeting, American Physical Society* (Talk).

Zhou B, Nemenman I,, and **Sober SJ** (2016). Nonlinear Bayesian cue integration explains the dynamics of vocal learning. *Annual Meeting, American Physical Society* (Talk).

Srivastava K, Holmes C, Vellema M, Elemans C, Nemenman I,, and **Sober SJ** (2016). A spike timing mechanism for respiratory motor control. *Annual Meeting, Society for the Neural Control of Movement* (Poster).

Holmes C, Srivastava K, Vellema M, Elemans C, Nemenman I,, and **Sober SJ** (2016). Songbird respiration is controlled by multispike patterns at millisecond temporal resolution. *Computational and Systems Neuroscience Meeting* (Poster).

Zhou B, Nemenman I,, and **Sober SJ** (2016). Nonlinear Bayesian cue integration explains the dynamics of vocal learning. *Computational and Systems Neuroscience Meeting* (Poster).

Hernandez D, Nemenman I,, and **Sober SJ** (2016). Deconstructing spike timing codes in single premotor neurons using Bayesian feature selection. *Computational and Systems Neuroscience Meeting* (Poster).

Hoffmann LA, Saravanan V, Wood AN , Li H, and **Sober SJ** (2015). Dopaminergic contributions to vocal learning. *Annual Meeting, Society for Neuroscience* (Poster).

Contributed Presentations (continued)

Wood AN and **Sober SJ** (2015). Catecholaminergic projections to song system nuclei in the Bengalese finch. *Annual Meeting, Society for Neuroscience* (Poster).

Saravanan V and **Sober SJ** (2015). Vocal generalization during reinforcement learning in songbirds. *Annual Meeting, Society for Neuroscience* (Poster).

Nicholson DA and **Sober SJ** (2015). Projections of the lateral deep cerebellar nuclei in Bengalese Finches. *Annual Meeting, Society for Neuroscience* (Poster).

Srivastava K and **Sober SJ** (2015). A micro-scale, flexible, high-density electrode array for performing multi and single motor unit electromyographic recordings. *IEEE/EMBS Conference on Neural Engineering* (Poster).

Nicholson DA, Roberts T, and **Sober SJ** (2015). Multiple pathways from the cerebellum to the forebrain through thalamus in a songbird. *Gordon Conference on the Cerebellum* (Poster).

Nicholson DA and **Sober SJ** (2014). Projections of the lateral deep cerebellar nuclei in Bengalese Finches. *Annual Meeting, Society for Neuroscience* (Poster).

Tang C, Srivastava K, Chehayeb D, Nemenman I, **Sober SJ** (2014). Millisecond-scale encoding in a cortical motor area in songbirds. *Annual Meeting, Society for Neuroscience* (Poster).

Srivastava K and **Sober SJ** (2014). A micro-scale, flexible electrode array for performing multi- and single motor unit electromyographic recordings of vocal muscles in songbirds. *Annual Meeting, Society for Neuroscience* (Poster).

Tang C, Srivastava K, Chehayeb D, Nemenman I, **Sober SJ** (2014). Precise temporal encoding in a vocal motor system. *Computational and Systems Neuroscience Meeting* (Poster).

Kelly CW and **Sober SJ** (2013). A single computational mechanism for both stability and flexibility in vocal error correction. *Computational and Systems Neuroscience Meeting* (Poster).

Srivastava KH and **Sober SJ** (2012). Control of multiple acoustic parameters by single vocal muscles in the Bengalese Finch. *Annual Meeting, Society for Neuroscience* (Poster).

Kelly CW and **Sober SJ** (2012). Age-related changes in the dynamics of vocal error correction. *Annual Meeting, Society for Neuroscience* (Poster).

Hoffmann LA** and **Sober SJ** (2012). Songbird vocal error correction local to single motor gestures. *Annual Meeting, Society for Neuroscience* (Poster).

Selected Media Attention

"Bird Brains to the Rescue", *The Scientist*, June, 2016

"In Class: How the Brain Creates Flavor", *Emory Alumni Magazine*, Summer 2016

"Academic Minute" (Podcast), *Northeast Public Radio - WAMC*, June 20, 2016

"Songbird Study Could Lead To Improved Prosthetic Limbs (For Humans)" *Atlanta Public Radio - WABE*, December 11, 2014

"Neuroscientists Talk Shop" (Podcast), *Produced by the University of Texas at San Antonio*, October 2, 2014

"Learning from Mistakes", *Popular Mechanics*, April, 2013

"Academic Minute" (Podcast), *Northeast Public Radio - WAMC*, February 27, 2013

Selected Media Attention (continued)

"How Birds Learn To Sing", *Popular Science*, Jan 2, 2013

"Studio sessions show how Bengalese finch stays in tune", *New Scientist*, December 21, 2012

"Meet the iFinch: The tiny headphones that can make a songbird change its tune (and could help us learn more effectively)" *The Daily Mail UK Online*; December 21, 2012

Teaching: Undergraduate and Graduate Courses

Emory University ..... Atlanta, GA
BIOL 485W/NBB470W: Advanced Techniques in Neuroscience Spring 2019
I developed this course, an advanced undergraduate seminar focusing on four recent technical innovations in neuroscience. This writing-intensive class included written responses to and classroom discussions of primary research literature, lab visits to see advanced techniques in action, and guest lectures by local faculty.
Enrollment: 7 students; 4 credit hours.

Emory University ..... Atlanta, GA
BIOL 190: Delicious! How the Brain Creates Flavor Spring 2016, Spring 2017
I developed this course, a first-year undergraduate seminar investigating the neurobiology of flavor perception. Class activities included discussions of primary research literature, cooking demonstrations, guest lectures by Atlanta chefs, and field trips to local restaurants.
Enrollment: 15 students; 3 credit hours.

Emory University ..... Atlanta, GA
BIOL 360: Introduction To Neurobiology Fall 2012, Fall 2013, Fall 2014, Fall 2017
Upper-level undergraduate lecture course covering cellular and integrative neurobiology.
Enrollment: 76, 110, and 114 students in 2012, 2013, and 2014 respectively; 3 credit hours.
Co-taught with Dr. Dieter Jaeger in 2014. Cross-listed as NBB301.

Emory University ..... Atlanta, GA
BIOL 360L: Neurosimulation laboratory Fall 2011, Fall 2012, Fall 2014
Undergraduate laboratory in computational neuroscience.
Enrollment: 15, 17, and 17 students in 2011, 2012, and 2014 respectively; 3 credit hours.
Co-taught with Dr. Dieter Jaeger in 2014. Cross-listed as NBB301L.

Emory University ..... Atlanta, GA
IBS 526: Systems Neuroscience (graduate course) Fall 2011, 2012, 2013, 2014, 2015, 2016
Twelve lectures total (two each year)
I received an Exemplary Lecturer Award for my work in this class; see Honors above.

Emory University ..... Atlanta, GA
BIO450/IBS534: Computational Neuroscience (mixed grad/undergrad) Spring 2014, 2015, 2016
Five lectures total (one or two each year)

Teaching: Community

Phillips State Prison ..... Buford, GA
Introduction to Neurobiology July-August 2016, July 2017
A survey of basic neuroscience concepts taught to inmates at Phillips State Prison, a maximum-security men's facility. This project was coordinated through Common Good Atlanta, a nonprofit which has taught

college level courses (previously only composition and literature classes) at Phillips for 8 years. Ours was the first natural science class taught in prison in the state of Georgia.
Enrollment: 17-20 students per year.
Co-taught with Andrea Pack, a graduate student in my lab.

Teaching: Invited International Training Courses

Emory-Tibet Science Initiative ..... Hubli, India
Instructor 5-6/2016
Taught neuroscience to Tibetan Buddhist monks as part of an initiative to provide Western scientific training to Tibetan monastics and foster dialogue between cultures.
Enrollment: 28 students

Perception and Action in Complex Environments (PACE) ..... Marseille, France
Instructor 1/2016
Instructor for PACE, an EU-funded multi-site graduate training program focusing on complex motor control.
Enrollment: 30 students

Champalimaud Neuroscience Programme ..... Lisbon, Portugal
Course Co-coordinator 2/2011, 3/2012
Co-coordinator (with Dr. Megan Carey) for a week-long graduate short course on the neural basis of learning.
Enrollment: 15-20 students per year.

Service

Departmental
Biology Undergraduate Research Symposium. Poster judge. 2012, 2013.
Biology BS/MS Program. Interim Coordinator. 2012.
Biology Departmental Assessment Committee. Member. 2012.
Emory Biology Department. Secretary for faculty meetings. 2010-2012.
Undergraduate Research in Biology (BIOL499R). Final report reviewer. 2014, 2015.
Emory Biology Department Internet Outreach Committee. Member. 2011-present.

Emory College
Emory Institute for Quantitative Theory and Methods (QuanTM). Advisory Board member. 2013-present.
Lecture-track Faculty Search Committee, Neuroscience & Behavioral Biology program. Member. 2012.

Graduate Programs
Emory Neuroscience Graduate Program. Director of Graduate Studies. 2018-present.
Emory Neuroscience Graduate Program. Standing Committee member. 2013-present.
Emory Neuroscience Graduate Program. Executive Committee member. 2013-present.
Emory Neuroscience Graduate Program. Awards Committee. Member. 2014-present; Chair, 2015-present.

National/International
Chapter President, Atlanta Chapter of the Society for Neuroscience.
Society for Neuroscience. Trainee Professional Development Awards Committee member. 2015-present
Society for Neuroscience. Trainee Professional Development Awards Committee member. 2015-present
Computational and Systems Neuroscience (COSYNE) conference. Program Committee member. 2014-2019

Reviewing and Editorial work (since starting at Emory in 2010)

Editorial:

Guest Academic Editor - PLoS Biology - 2017 (2), 2018 (2)

Journal Article Reviews:

Nature - 2014 (3)
Nature Neuroscience - 2014 (2)
Nature Communications - 2014 (2), 2018
PLoS Biology - 2016, 2017
PLoS Computational Biology - 2016, 2018
PLoS ONE - 2011, 2013 (2), 2017
eLife - 2013, 2014, 2015 (3), 2016 (3), 2017 (3)
Journal of Neuroscience - 2011, 2016, 2017
Journal of the Acoustical Society of America - 2013
Journal of Neurophysiology - 2010, 2011 (2), 2012, 2015, 2016, 2017, 2018 (2)
Frontiers in Neuroscience - 2010, 2016, 2017 (2)
Hearing Research - 2014
Journal of Visualized Experiments - 2012
Brain Research - 2012 (2)
Neuroscience - 2016 (3)

External Grant Reviews:

NIH (NICHD), K99 review panel, October 2018
NSF/NIH, CRCNS (Collaborative Research in Computational Neuroscience) panel, March 2017
NSF, Science of Learning panel, April 2017
Fondation Pour l'Audition (French non-profit organization for hearing research), June 2017
French National Research Agency (ANR), May 2016
NIH, ZRG1 IFCN-T(02), ad hoc member, March 2016
Louisiana State Board of Regents Pilot Funding Program, November 2013
NSF, Processes, Structures and Integrity Program, ad hoc member, September 2012
NSF CAREER Awards panel, ad hoc member, October 2011

Member of Graduate Thesis Committee

Jim Kwon, Neuroscience Graduate Program (Active)
Erica Landis, Neuroscience Graduate Program (Active)
Rhett Morrissette, Neuroscience Graduate Program (Active)
Alex Dunlap, Biomedical Engineering Program (Active)
Kara Kittelberger, Neuroscience Graduate Program (Obtained Ph.D. Fall 2017)
Elizabeth Ann Amadei, Biomedical Engineering Program (Obtained Ph.D. Spring 2017)
Katy Shepard, Neuroscience Graduate Program (Obtained Ph.D. Fall 2014)
Wafa Soofi, Biomedical Engineering Program (Obtained Ph.D. Spring 2013)

Member of Undergraduate Honors Thesis Committee

Elizabeth O'Gorman (2018) Advisor: Dr. Gordon Berman (Biology)
Celia Greenlaw (2016) Advisor: Dr. Robert Hampton (Psychology)
Minagi Ozawa (2015) Advisor: Dr. Gary Miller (School of Public Health)
Zahra Manji (2015) Advisor: Dr. Thota Ganesh (School of Medicine/Pharmacology)
Nawoo Kim (2015) Advisor: Dr. Nicholas Boulis (School of Medicine/Neurology)
Erdong Chen (2015) Advisor: Dr. Yoland Smith (School of Medicine/Neurology)
Patrick Curtin (2015) Advisor: Dr. David Weinshenker (School of Medicine//Human Genetics)
Nicholas Thompson (2013) Advisor: Dr. Arthur English (School of Medicine/Cell Biology)

Symposia/Meetings Organized

Co-organizer (with Timothy Gentner), "Birdsong 2018: Out on a limb (unpublished data and new theories)," a satellite meeting of the 2018 Society for Neuroscience Conference with approximately 160 attendees from around the workd (held at UC San Diego on November 2, 2018).

Co-organizer (with William Bialek and Stephanie Palmer), "Quantitative Approaches to Naturalistic Behaviors," a workshop for 29 neurobiologists, mathematicians, and physicists (held at the Banbury Center, Lloyd,Harbor, New York on September 23-26, 2018).

Organizer and Chair, "Transforming errors into skills: from spike trains to behavior and back again," a symposium held at the semi-annual Federation of European Neuroscience Unions (FENS) meeting, Berlin, Germany (July 8, 2018). Approximately 300 people attended the symposium.

Co-organizer (with Simon Sponberg and David Hofmann) and Chair, "New Directions in Motor Control," a symposium with roughly 200 attendees from around the United States and Canada (held at Emory University on May 18-19, 2017).

Co-organizer (with Robert Liu) of "Learning About the Vocal World," a symposium with roughly 100 attendees from around the country (held at Emory University on May 20, 2015).

Primary and Secondary School Outreach:

High School Students Supervised: Reid Schwartz (Summer 2013).
Presentation on human neuroanatomy to students at Briarlake Elementary School (Atlanta, GA 2014).
Presentation on songbird neuroscience to students at Martin Luther King, Jr. Middle School (Atlanta, GA 2016).
Visits to lab by students from Jeremiah Towers High School (Atlanta, GA 2011, 2012, 2013).
Science fair judge at Fred Armon Toomer Elementary School (Atlanta, GA, 2011)