

Bruce A. Carlson

Associate Professor
Department of Biology
Washington University in St. Louis
One Brookings Drive, Campus Box 1137
415 Monsanto Laboratory, St. Louis, MO 63130-4899
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EDUCATION

University of Miami, Coral Gables, FL

B.S. Biology & Marine Science (with honors, magna cum laude and chemistry minor), 1997
Thesis: Deterrent properties of *Aplysia* ink are mediated by chemoreceptors in the predatory crab *Cancer antennarius*
Research Advisor: Prof. Thomas G. Nolen

Cornell University, Ithaca, NY

Ph.D. Neurobiology & Behavior, 2003
Thesis: Mechanisms of stereotyped temporal pattern generation in mormyrid electric fish
Research Advisor: Prof. Carl D. Hopkins

PROFESSIONAL EXPERIENCE

University of Virginia, Charlottesville, VA

Postdoctoral Associate (2003-2004)
Research Advisor: Prof. Masashi Kawasaki

University of Virginia, Charlottesville, VA

NIH-NRSA Postdoctoral Research Fellow (2004-2007)
Research Advisor: Prof. Masashi Kawasaki

Cornell University, Ithaca, NY

Postdoctoral Associate (2007-2008)
Research Advisor: Prof. Carl D. Hopkins

Washington University, St. Louis, MO

Assistant Professor, Department of Biology (2008-2014)
Associate Professor with Tenure, Department of Biology (2014-present)

TEACHING ACTIVITIES

Washington University Course Master

Bio 404, *Laboratory of Neurophysiology* (Fall 2008, 2010-2014; 18-36 students, 6-8 hours lecture, 109-129 hours laboratory)
Bio 3421, *Introduction to Neuroethology* (Spring 2010, 2012, 2014, 2016; 29-48 students, 37.5 hours lecture)
Bio 200/500, *Independent Study* (Spring/Fall 2008-2016; 1-4 students per semester)

Washington University Co-Instructor/Guest Lecturer

Bio 5651: *Neural Systems* (Spring 2009-2016; 19-33 students, 3 hours lecture, 3 hours laboratory, 1 hour discussion)

Bio 372: *Behavioral Ecology* (Spring 2009; 136 students, 1 hour lecture)

Bio 5571: *Cellular Neurobiology* (Fall 2009; 11 students, 1.5 hours lecture)

Bio 5926: *Neuroscience & Behavior* (Summer 2010; 30 students, 3 hours laboratory)

Bme 572: *Biological Neural Computation* (Spring 2012, 23 students; 1.5 hours lecture)

Cornell University Graduate Teaching Assistant

BioNB 491, *Principles of Neurophysiology* (Fall 1998)

BioNB 221, *Introduction to Behavior* (Fall 2000)

BioNB 222, *Introduction to Neurobiology* (Spring 2001)

BioNB 424, *Neuroethology* (Spring 2002)

Cornell University Guest Lecturer

BioEE 424, *Neuroethology* (2 lectures, Spring 2002; 1 lecture, Fall 2007)

BioEE 476, *Biology of Fishes* (1 lecture, Fall 2002)

BioNB 720, *Academic Skills for Biologists* (1 lecture, Fall 2007)

HONORS, AWARDS AND FELLOWSHIPS

Blavatnik Awards for Young Scientists, Washington University Nominee (2015)

Excellence in Teaching Award, Arts & Sciences Council, Washington University (2014)

Travel Fellowship, Winter Conference on Brain Research (2014)

NIH-NRSA Postdoctoral Research Fellowship (2004-2007)

NIH Predoctoral Training Grant (2002-2003)

Outstanding Teaching Assistant of the Year, Cornell University (2002)

NSF Predoctoral Fellowship (1998-2002)

Sage Predoctoral Fellowship, Cornell University (1997-1998)

Magna cum laude, University of Miami (1997)

Departmental Honors in Marine Science, University of Miami (1997)

Departmental Honors in Biology, University of Miami (1997)

PUBLICATIONS IN PEER-REVIEWED JOURNALS

1. Baker CA, Ma L, Casareale CR & Carlson BA (2016) Behavioral and single-neuron sensitivity to millisecond variations in temporally patterned communication signals. **The Journal of Neuroscience** in press.
2. Vélez A and Carlson BA (2016) Detection of transient synchrony across oscillating receptors by the central electrosensory system of mormyrid fish. **eLife** 5: e16851.
3. Carlson BA (2016) Differences in electrosensory anatomy and social behavior in an area of sympatry between two species of mormyrid electric fishes. **Journal of Experimental Biology** 219: 31-43.
4. Baker CA, Huck KR and Carlson BA (2015) Peripheral sensory coding through

- oscillatory synchrony in weakly electric fish. **eLife** 4: e08163 [Featured in PhysOrg, Electronics Weekly, Newswise, Futurity, redOrbit].
5. Carlson BA (2015) Animal behavior: Electric eels amp up for an easy meal. **Current Biology** 25: R1070-R1072.
 6. Baker CA and Carlson BA (2014) Short-term depression, temporal summation, and onset inhibition shape interval tuning in midbrain neurons. **The Journal of Neuroscience** 34: 14272-14287.
 7. Kohashi T and Carlson BA (2014) A fast BK-type K_{Ca} current acts as a postsynaptic modulator of temporal selectivity for communication signals. **Frontiers in Cellular Neuroscience** 8: 286.
 8. Lyons-Warren AM, Kohashi T, Mennerick S and Carlson BA (2013) Detection of submillisecond spike timing differences based on delay-line anti-coincidence detection. **Journal of Neurophysiology** 110: 2295-2311.
 9. Stevens JA, Sukhum KV and Carlson BA (2013) Independent evolution of visual and electrosensory specializations in different lineages of mormyrid electric fishes. **Brain Behavior and Evolution** 82: 185-198.
 10. Baker CA, Kohashi T, Lyons-Warren AM, Ma X and Carlson BA (2013) Multiplexed temporal coding of electric communication signals in mormyrid fishes. **The Journal of Experimental Biology** 216: 2365-2379.
 11. Ma X, Kohashi T and Carlson BA (2013) Extensive excitatory network interactions shape temporal processing of communication signals in a model sensory system. **Journal of Neurophysiology** 110: 456-469.
 12. Carlson BA and Gallant JR (2013) From sequence to spike to spark: Evo-devo-neuroethology of electric communication in mormyrid fishes. **Journal of Neurogenetics** 27: 106-129.
 13. Lyons-Warren AM, Kohashi T, Mennerick S and Carlson BA (2013) Retrograde fluorescent labeling allows for targeted extracellular single-unit recording from identified neurons *in vivo*. **Journal of Visualized Experiments** 76: e3921.
 14. Lyons-Warren AM, Hollmann M and Carlson BA (2012) Sensory receptor diversity establishes a peripheral population code for stimulus duration at low intensities. **The Journal of Experimental Biology** 215: 2586-2600.
 15. Carlson BA (2012) Diversity matters: The importance of comparative studies and the potential for synergy between neuroscience and evolutionary biology. **Archives of Neurology** (now JAMA Neurology) 69: 987-993.
 16. Klug A, Borst JGG, Carlson BA, Kopp-Scheinflug C, Klyachko VA and Xu-Friedman MA (2012) How do short-term changes at synapses fine-tune information processing? **The Journal of Neuroscience** 32: 14058-14063.
 17. Carlson BA, Hasan SM, Hollmann M, Miller DB, Harmon LJ and Arnegard ME (2011) Brain evolution triggers increased diversification of electric fishes. **Science** 332: 583-586 [Faculty of 1000 "Exceptional"; Featured in Discover, Science News,

Science Daily, PhysOrg, The Naked Scientists, Wired, Futurity, redOrbit, Gizmodo, io9].

18. George AA, Lyons-Warren AM, Ma X and Carlson BA (2011) A diversity of synaptic filters are created by temporal summation of excitation and inhibition. **The Journal of Neuroscience** 31: 14721-14734.
19. Gallant JR, Arnegard ME, Sullivan JP, Carlson BA and Hopkins CD (2011) Signal variation and its morphological correlates in *Paramormyrops kingsleyae* provide insight into the evolution of electrogenic signal diversity in mormyrid electric fish. **Journal of Comparative Physiology A** 197: 799-817.
20. Carlson BA and Arnegard ME (2011) Neural innovations and the diversification of African weakly electric fishes. **Communicative & Integrative Biology** 4: 720-725.
21. Carlson BA (2009) Temporal-pattern recognition by single neurons in a sensory pathway devoted to social communication behavior. **The Journal of Neuroscience** 29: 9417-9428 [Faculty of 1000 "Must Read"; featured in This Week in the Journal].
22. Carlson BA and Kawasaki M (2008) From stimulus estimation to combination sensitivity: Encoding and processing of amplitude and timing information in parallel, convergent sensory pathways. **Journal of Computational Neuroscience** 25: 1-24.
23. Carlson BA (2008) Phantoms in the brain: Ambiguous representations of stimulus amplitude and timing in weakly electric fish. **Journal of Physiology – Paris** 102: 209-222.
24. Carlson BA and Kawasaki M (2007) Behavioral responses to jamming and 'phantom' jamming stimuli in the weakly electric fish *Eigenmannia*. **Journal of Comparative Physiology A** 193: 927-941.
25. Carlson BA and Kawasaki M (2006) Ambiguous encoding of stimuli by primary sensory afferents causes a lack of independence in the perception of multiple stimulus attributes. **The Journal of Neuroscience** 26: 9173-9183.
26. Carlson BA and Kawasaki M (2006) Stimulus selectivity is enhanced by voltage-dependent conductances in combination-sensitive neurons. **Journal of Neurophysiology** 96: 3362-3377.
27. Arnegard ME and Carlson BA (2005) Electric organ discharge patterns during group hunting by a mormyrid fish. **Proceedings of the Royal Society B: Biological Sciences** 272: 1305-1314 [Featured in Wissenschaften-Online].
28. Carlson BA and Kawasaki M (2004) Nonlinear response properties of combination-sensitive electrosensory neurons in the midbrain of *Gymnarchus niloticus*. **The Journal of Neuroscience** 24: 8039-8048 [Faculty of 1000 "Recommended"; featured in This Week in the Journal].
29. Carlson BA and Hopkins CD (2004) Stereotyped temporal patterns in electrical communication. **Animal Behaviour** 68: 867-878.
30. Carlson BA and Hopkins CD (2004) Central control of electric signaling behavior in the

mormyrid *Brienomyrus brachyistius*: Segregation of behavior-specific inputs and the role of modifiable recurrent inhibition. **The Journal of Experimental Biology** 207: 1073-1084 [Featured in Inside JEB].

31. Carlson BA (2003) Single-unit activity patterns in nuclei that control the electromotor command nucleus during spontaneous electric signal production in the mormyrid *Brienomyrus brachyistius*. **The Journal of Neuroscience** 23: 10128-10136.
32. Carlson BA (2002) Neuroanatomy of the mormyrid electromotor control system. **The Journal of Comparative Neurology** 454: 440-455.
33. Carlson BA (2002) Electric signaling behavior and the mechanisms of electric organ discharge production in mormyrid fish. **Journal of Physiology – Paris** 96: 405-419.
34. Carlson BA, Hopkins CD and Thomas P (2000) Androgen correlates of socially induced changes in the electric organ discharge waveform of a mormyrid fish. **Hormones and Behavior** 38: 177-186.
35. Carlson BA and Bass AH (2000) Sonic/vocal motor pathways in squirrelfish (Teleostei, Holocentridae). **Brain Behavior and Evolution** 56: 14-28.

BOOK CHAPTERS

1. Tricas TC and Carlson BA (2012) Electroreceptors and magnetoreceptors. In: **Cell Physiology Sourcebook: Essentials of Membrane Biophysics** (Sperelakis N, ed.), 4th ed, pp. 705-725. Elsevier.
2. Carlson BA (2011) Detection and generation of electric signals in fishes: An introduction. In: **Encyclopedia of Fish Physiology: From Genome to Environment** (Farrell AP, ed.), vol. 1, pp. 347-349. Academic Press.
3. Carlson BA (2009) Reafferent control in electric communication. In: **Encyclopedia of Neuroscience** (Binder MD, Hirokawa N, Windhorst U and Hirsch MC, eds.), pp. 3368-3373. Springer.
4. Carlson BA (2009) Temporal coding in electroreception. In: **Encyclopedia of Neuroscience** (Binder MD, Hirokawa N, Windhorst U and Hirsch MC, eds.), pp. 4039-4044. Springer.
5. Carlson BA (2006) A neuroethology of electrocommunication: Senders, receivers, and everything in between. In: **Communication in Fishes** (Ladich F, Collin SP, Moller P and Kapoor BG, eds.), pp. 805-848. Science Publishers.
6. Caputi AA, Carlson BA and Macadar O. (2005) Electric organs and their control. In: **Electroreception** (Bullock TH, Hopkins CD, Popper A and Fay RR, eds.), pp. 410-451. Springer.

GRANT SUPPORT

Current Support

PI: Carlson, *Brain Evolution, Communication, and the Diversification of Behavior*, NSF-IOS-1255396; \$632,000 total cost, 7/2013-6/2017.

PI: Carlson, *Research Experience for Undergraduates Supplement to NSF-IOS-1255396*, NSF-IOS-1137071; \$6000 total cost, 7/2013-6/2017.

Pending Support

PI: Carlson, *Bioenergetics and the Evolution of Extreme Encephalization*, NSF-IOS preliminary proposal invited for full proposal submission.

Past Support

PI: Carlson, *Synaptic Mechanisms for the Processing of Temporal Codes*, NSF-IOS-1050701; \$581,304 total cost, 3/2011-2/2015.

PI: Carlson, *Research Experience for Undergraduates Supplement to NSF-IOS-1050701*, NSF-IOS-1137071; \$6250 total cost, 3/2011-2/2015.

PI: Carlson, *JSPS Postdoctoral Fellowship for Research Abroad for Tsunehiko Kohashi: Neuronal Basis for Sensory Coding with High-Temporal Resolution in Weakly Electric Fish*, approx. \$104,000 total cost (JPY 10,512,000), 4/2013-1/2015.

PI: Carlson, *NRSA Predoctoral Fellowship for Christa A. Baker: Synaptic Mechanisms of Temporal Pattern Recognition*, NIDCD-F31-DC012452; \$60,078 total cost, 1/2013-12/2014.

PI: Carlson, *NRSA Predoctoral Fellowship for Ariel M. Lyons-Warren: Multiple Roles of Inhibition in Temporal Coding*, NIDCD-F30-DC011197; \$111,854 total cost, 5/2010-4/2013.

PI: Carlson, co-PIs: Yoichi Oda, Ken Kitajima and Masahiko Hibi, *JSPS Young Researcher Overseas Visits Program for Vitalizing Brain Circulation, Travel Stipend for Tsunehiko Kohashi: Integrative Studies on Formation and Function of Brain Networks*, G2205, approx. \$712,000 total cost (JPY 61,036,000) (Carlson Lab: approx. \$91,000 total cost), 2/2011-3/2013.

PI: Carlson, co-PI: Carl Hopkins, *Collaborative Research: Mechanisms of Signal Diversity in Communication*, NSF-IOS-0818390 (Carlson lab) and NSF-IOS-0818305 (Hopkins lab); \$404,317 total cost (Carlson lab: \$203,183 total cost), 8/2008-7/2012.

PI: Carlson, *Research Experience for Undergraduates Supplement to NSF-IOS-0818390*, NSF-IOS-0940424; \$6000 total cost, 8/2008-7/2012.

PI: Carlson, *Uehara Memorial Foundation Postdoctoral Fellowship for Tsunehiko Kohashi: Neuronal Basis for Analyzing Temporal Structure of Sensory Signals with Microsecond Resolution*, approx. \$43,000 total cost (JPY 4,000,000), 4/2010-3/2011.

PI: Carlson, *Decoding Temporal Patterns through Short-Term Synaptic Plasticity*, McDonnell Center for Systems Neuroscience; \$84,800 total cost, 7/2008-6/2010.

PI: Carlson, *Postsynaptic Potential Interactions in Sensory Neurons*, NINDS-F32-NS049788; \$142,700 total cost, 8/2004-8/2007.

MENTORING ACTIVITIES

Ph.D. Students (1 current*, 2 graduated)

Ariel M. Lyons-Warren (2008-2012), MSTP, Neuroscience Program. Thesis: *Processing Submillisecond Timing Differences in a Model Electrosensory System*. Currently a resident at Texas Children's Hospital in Houston, TX.

Christa A. Baker (2009-2015), Neuroscience Program. Thesis: *Peripheral and Central Mechanisms of Temporal Pattern Recognition*. Currently a postdoctoral fellow at Princeton University.

*Kimberley Sukhum (2012-present), Ecology, Evolution, and Population Biology Program. Thesis: *Costs and Benefits of Extreme Encephalization*.

Postdoctoral Associates (1 current*, 5 completed)

Michael Hollmann (2009-2010) Currently a Research Scientist in Cologne, Germany.

Andrew A. George (2009-2010) Currently a Research Assistant Professor in the Department of Neurobiology, Barrow Neurological Institute, Phoenix, AZ.

Michael Orr (2011-2012) Currently an Assistant Professor in the Department of Biology, Cape Breton University, Sydney, Nova Scotia, Canada.

Xiaofeng Ma (2011-2014) Currently a Research Scientist at Washington University School of Medicine.

Tsunehiko Kohashi (2010-2015) Currently a Lecturer at Nagoya University, Japan.

*Alejandro Vélez (2014-present)

Undergraduate Researchers (7 current*, 33 total)

Jacob Pieper (2008) Biology Major, Washington University.

Alyssa Pagliere (2008) Biology Major, Washington University.

Hannah Wroblewski (2008-2009) Physics Major, Washington University.

Mary E. Hinton (2009-2010) Environmental Studies Major, Washington University.

Derek B. Miller (2009-2010) Biology Major with Honors, Washington University.

Arielle B. Grossman (2009-2010) Biology Major, Washington University.

Saad M. Hasan (2008-2010) Biology Major with Honors, Washington University.

Michelle L. McMahon (2010). Zoology Major, University of Wisconsin-LaCrosse.

Alex Z. Feng (2010-2011) Biology Major, Washington University.

Lisa Ma (2011-2012) Biology Major, Washington University.

Joseph A. Bernardi (2012) Biology and Music Major, Washington University.

Kiron Sukeson (2012-2013) Biomedical Engineering Major, Washington University.

Jennifer Stevens (2009-2013) Biology Major, Washington University.

Chelsea R. Casareale (Biology Major, 2011-2013) Biology Major, Washington University.

Robert Wang (2011-2013) Biology Major, Washington University.

Diana Jerome (2012) Biology Major, Washington University.

Kevin Huck (2013) Biology Major, Missouri Baptist University.

Elijah Lowenstein (2013) Psychology Major, Washington University.

Jenny Yang (2013-2014) Biology Major, Washington University.
Nancy Fang (2013-2014) Biology Major, Washington University.
Ashni Patel (2014) Biology Major, Washington University.
Jessica Hayes (2014) Biology Major, Washington University.
Prema Roberts-Gaddipati (2013-2014) Biology Major, Washington University.
Tiffany Lin (2015) Biology Major, Washington University.
Megan Freiler (2013-2016) Biology Major, Washington University.
Ji-Yun Suh (2014-2016) Biology Major, Washington University.
*Da Yeon Ryoo (2014-present) Biology Major, Washington University.
*Anan Lu (2015-present) Biology Major, Washington University.
*Snighda Srivastava (2015-present) Biology Major, Washington University.
*Rishi Patel (2016-present) Biology Major, Washington University.
*Jerry Shen (2016-present) Biology Major, Washington University.
*Alison Setili (2016-present) Biology Major, Washington University.
*Samuel Schell (2016-present) Biology Major, Washington University.

Research Technicians

Gary London (2008-2010) University of Wisconsin, Psychology Major. Currently a research technician at Washington University School of Medicine.
Conor Gearin (2015) Truman State University, Biology and English Major. Currently a freelance science reporter.

Student and Postdoc Awards and Fellowships:

Saad M. Hasan: HHMI-SURF Fellowship (2009), SURF Undergraduate Travel Award (2009)
Michael Hollmann: DAAD German Academic Exchange Postdoctoral Fellowship (2009)
Ariel M. Lyons-Warren: First Place at Washington University Graduate Research Symposium (2009), NIH-NRSA Predoctoral Fellowship (2010)
Christa A. Baker: CCSN Training Grant (2010), NIH-NRSA Predoctoral Fellowship (2012), Society for Neuroscience Travel Award Nominee for St. Louis Chapter (2013), International Society for Neuroethology Graduate Student Representative on Council (2013-2015), O'Leary Prize for Neuroscience Finalist (2015)
Tsunehiko Kohashi: Uehara Memorial Foundation Postdoctoral Fellowship (2010), JSPS Young Researcher Overseas Visits Program for Vitalizing Brain Circulation (2011), JSPS Postdoctoral Fellowship for Research Abroad (2013)
Jennifer Stevens: HHMI-SURF Fellowship (2011), C-SURE Fellowship (2012), Spector Prize in Biology Award Winner (2013)
Chelsea R. Casareale: HHMI-SURF Fellowship (2012)
Megan Freiler: HHMI-SURF Fellowship (2014), Career Center Fellowship (2015)
Ji-Yun Suh: Career Center Fellowship (2015)
Da Yeon Ryoo: HHMI-SURF Fellowship (2015)
Anan Lu: uSTAR Fellowship (2015), HHMI-SURF Fellowship (2016)
Jerry Shen: Career Center Fellowship (2016)

Ph.D. Student Rotations

Edward Siuda (2011), Neuroscience, Michael Bruchas Lab
Matheus Araujo (2012), Neuroscience, Andrew Yoo Lab

Tahnbee Kim (2012), Neuroscience, Daniel Kerschensteiner Lab
Cody Greer (2013), Neuroscience, Timothy Holy Lab
Asa Earnest (2013), Ecology, Evolution, and Population Biology, Kerry Kornfield Lab
Xitong Liang (2014), Neuroscience, Paul Taghert Lab
Cody Burleson (2015), Neuroscience, Steve Mennerick Lab
Erika Schumacher (2016), Ecology, Evolution, and Population Biology
Adalee Lube (2016), Neuroscience

Ph.D. Thesis Committee Member

Washington University in St. Louis:

Jing Shao (2009; Physics), Mark Freeman (2009-2011; MSTP, Neuroscience Program),
Diwakar Turaga (2010; MSTP, Neuroscience Program), Matthew Caudill (2011; Physics),
Kristin Powell (2011-2013; Ecology, Evolution, and Population Biology Program), Kathleen
Zelle (2011-2016; Ecology, Evolution, and Population Biology Program), Elizabeth Atkinson
(2013; Ecology, Evolution, and Population Biology Program), Chao Li (2013-2015;
Biomedical Engineering), Sarah Helgren (2013-2015; Biomedical Engineering), Xinguo
Zheng (2014; Neuroscience), Thomas Crockett (2014; Physics), Wengsheng Sun (2014-
present; Biomedical Engineering), Ross McKinney (2014-present; Neuroscience), Haoyang
Rong (2015-present; Biomedical Engineering), Cassondra Vernier (2016-present; Ecology,
Evolution, and Population Biology Program), Katherine Heisey (2016-present;
Neuroscience)

Other Institutions:

Tara Deemyad (2012; Neuroscience Program, McGill University),

Qualifying Examination Committee Member: Ruiye Ni (2011, Biomedical Engineering),
Nalin Katta (2011, Biomedical Engineering), Jeff Gamble (2012, Biomedical Engineering),
Cody Greer (2013, Neuroscience), Kati Conen (2013, Neuroscience), Zhen Peng (2014,
Evolution, Ecology and Population Biology), Katherine Heisey (2015, Neuroscience),
Moises Arriaga (2016, Neuroscience), Zhikai Liu (2016, Neuroscience)

Undergraduate Advising: 5 current and 39 graduated advisees

Recommendation Letters for MD, PhD, DVM, and Masters Programs: 5-15 annually

Faculty Advisor: Washington University International Prehealth Society (2010)

WASHINGTON UNIVERSITY SERVICE

Midstates Consortium for Math and Science: Executive Committee Member (2012-
present); Faculty Representative at the Undergraduate Research Symposium in the
Biological Sciences and Psychology, University of Chicago (2010, 2012, 2014), Washington
University (2013)

Cognitive, Computational, and Systems Neuroscience Curriculum Pathway: Steering
Committee (2016-present)

Neuroscience Colloquium: Faculty Representative for the Department of Biology (2009-present)

Hamburger Committee: Selection of the annual Hamburger Lecturer hosted by the Department of Biology (2013-present)

Award Committees: Spector Prize Committee (2011); HHMI-SURF Undergraduate Travel Award Committee (2012); Thomas Thach Memorial Award Committee (2014); HHMI-SURF Summer Research Fellowship Committee (2015)

Search Committees: Evolutionary Biologist search for the Department of Biology (2013-2014); Neuroscientist search for the Department of Biology (2015-2016)

SERVICE BEYOND WASHINGTON UNIVERSITY

Editorial Boards: Brain, Behavior and Evolution (2012-present)

Professional Society Committees: Program Committee, J.B. Johnston Club for Evolutionary Neuroscience (2014-present); Executive Committee, J.B. Johnston Club for Evolutionary Neuroscience (2014-present); Council Representative, International Society for Neuroethology (2014-present)

Scientific Advisor: *Chisembe: Shadow Hunters of Malawi*, a finalist in three categories at the International Wildlife Film Festival, Missoula, MT (2005)

Book and Journal Editor: Guest Issue Editor: Electrosensory Systems, *Journal of Physiology – Paris* 102: 153-374 (2008); Review Editor: *Frontiers in Aquatic Physiology* (2010-present); Section Editor: Detection and Generation of Electric Signals in Fishes, *In: Encyclopedia of Fish Physiology: From Genome to Environment pp. 347-415* (2010)

Grant Panels: NSF pre-proposal panel (2013); NSF full proposal panel (2013)

Ad hoc Grant Reviewer (2-5 grants annually): NSF-IOS-Behavioral Systems, NSF-IOS-Neural Systems, NSF-CRCNS-Collaborative Research in Computational Neuroscience, Natural Sciences and Engineering Research Council of Canada (NSERC), Human Frontier Science Program Career Development Award Program, Swedish Research Council (Formas), Portuguese Foundation for Science and Technology (FCT), Sigma Xi, Louisiana Board of Regents Support Fund Research Competitiveness Subprogram

Journal Reviewer (15-30 manuscripts annually): Behavioral Ecology and Sociobiology, Behaviour, The Biological Bulletin, Biology Letters, BMC Genomics, Current Biology, Developmental Brain Research, eLife, Ethology, Evolution, Frontiers in Computational Neuroscience, Frontiers in Neuroinformatics, Frontiers in Zoology, Hormones and Behavior, Journal of Comparative Physiology A, The Journal of Experimental Biology, Journal of Neurophysiology, The Journal of Neuroscience, Journal of Neuroscience Methods,

Journal of Physiology – Paris, Journal of the Royal Society Interface, Journal of Visualized Experiments, Nature Communications, Nature Reviews Neuroscience, Neuroscience, Neuroscience Letters, Physiology and Behavior, PLoS Biology, PLoS Computational Biology, PLoS One, Proceedings of the National Academy of Sciences, Proceedings of the Royal Society B: Biological Sciences, Scientific Reports, Synapse

Book Reviewer: Hill RW, Wyse GA and Anderson M (2012) Chapter 14, Sensory Processes. In: *Animal Physiology*, 3rd ed., Sunderland, MA: Sinauer; Zupanc GK (2016) *Behavioral Neurobiology*, 3rd ed., New York, NY: Oxford University Press

Symposium Organizer and Chair: 9th International Congress of Neuroethology, Salamanca, Spain: *Computational Mechanisms in Temporal Processing* (2010)

Membership in Professional Scientific Societies: American Association for the Advancement of Science, Animal Behavior Society, International Society for Neuroethology, J.B. Johnston Club for Evolutionary Neuroscience, Society for Neuroscience

PUBLIC OUTREACH ACTIVITIES

Media Coverage: Journal of Neuroscience ‘This Week in the Journal’ (2004, 2009), The Journal of Experimental Biology ‘Inside JEB’ (2004, 2013), Wissenschaften-Online (2005), Discover (2011), Science News (2011), Science Daily (2011), PhysOrg (2011), The Naked Scientists (2011), Wired (2011), redOrbit (2011), Futurity (2011), Gizmodo (2011), io9 (2011), WUSTL Record (2011), Southwest Airlines’ Spirit Magazine (2013), Podcast Interview for “People Behind the Science” (2014), PhysOrg (2015), Electronics Weekly (2015), Futurity (2015), Newswise (2015), redOrbit (2015), WUSTL Record (2015)

Outreach: Interactive demonstrations at *Old Bonhomme Elementary School* in Olivette, MO (2009); Interactive demonstrations at *NeuroDay* at the St. Louis Science Center, part of the Society for Neuroscience *Brain Awareness Week* (each March, 2009-present); Interactive demonstrations at the *St. Louis Area Brain Bee* (each January, 2011-present); Officiating Judge at the *St. Louis Area Brain Bee* (each January, 2011-present)

INVITED LECTURES

1. University of Illinois Urbana-Champaign, Neuroscience Program, Graduate Student Invited Speaker (2017)
2. Cornell University, Department of Neurobiology and Behavior (2016)
3. Society for Neuroscience Annual Meeting; San Diego, CA; Birdsong 6 Satellite Meeting: Integrating neural, social, and evolutionary influences on communication (2016)
4. 12th International Congress of Neuroethology; Montevideo, Uruguay; Participant Symposium (2016)
5. 12th International Congress of Neuroethology; Montevideo, Uruguay; Satellite Meeting: Electric Fish (2016)
6. 12th International Congress on the Biology of Fish; San Marcos, TX; Symposium:

- Sensing the Environment: Molecules to Populations (2016)
7. Washington University, Department of Genetics (2016)
 8. Washington University, Institute for School Partnership, Darwin Day (2016)
 9. University of Ottawa, Department of Biology (2015)
 10. McGill University, Organismal Seminar Series (2015)
 11. Louisiana State University – Health Sciences Center, Department of Cell Biology and Anatomy (2014)
 12. Winter Conference on Brain Research; Steamboat Springs, CO; Panel: Evolvability of Behavior: Genes, Development, and Neural Circuits (2014)
 13. Wesleyan University, Department of Biology (2013)
 14. Washington University, Department of Anatomy & Neurobiology (2013)
 15. Southern Illinois University – Edwardsville, Department of Biological Sciences (2013)
 16. Society for Neuroscience Annual Meeting; New Orleans, LA; Minisymposium: How Do Short-Term Changes at Synapses Fine-Tune Information Processing? (2012)
 17. University at Buffalo, SUNY, Department of Biological Sciences (2012)
 18. St. Louis University, Department of Biology (2012)
 19. St. Louis Area Undergraduate Research Symposium, Keynote Speaker (2012)
 20. Marine Biological Laboratory, Woods Hole, MA, Grass Fellows Invited Speaker (2012)
 21. Nagoya University, Japan; Symposium: Integrative Studies on Formation and Function of Brain Networks, Principal Speaker (2012)
 22. 14th European Congress of Ichthyology; Liège, Belgium; Symposium: Adaptive Brain Morphology and Neuroanatomy in Fishes (2012)
 23. Computational Neuroscience Annual Meeting; Atlanta, GA; Workshop: Computational Neuroethological Approaches to Problems in Social Neuroscience (2012)
 24. Indiana University, Evolution, Ecology and Behavior Seminar Series (2011)
 25. Grinnell College, Department of Biology (2011)
 26. McGill University, Mont-Saint-Hilaire Electric Fish Meeting (2011)
 27. Brandeis University, Neuroscience Program, Graduate Student/Postdoc Invited Speaker (2010)
 28. 9th International Congress of Neuroethology; Salamanca, Spain; Symposium: Computational Mechanisms in Temporal Processing (2010)
 29. University of Texas, Section of Neurobiology (2009)
 30. Northwestern University, Department of Neurobiology & Physiology (2009)
 31. Washington University, Medical Scientist in Training Program (2009)
 32. 3rd Mediterranean Conference of Neuroscience; Alexandria, Egypt; Symposium: Mormyrid Fishes in Myth, Membranes and Molecules (2009)
 33. McGill University, Mont-Saint-Hilaire Electric Fish Meeting (2009)
 34. Washington University, Department of Anatomy & Neurobiology (2008)
 35. Washington University, Evolution, Ecology & Population Biology (2008)
 36. 8th International Congress of Neuroethology; Vancouver, Canada; Satellite Meeting: Electrosensory Systems (2007)
 37. Hunter College – City University of New York, Department of Psychology (2007)
 38. University of Ottawa, Department of Biology (2007)
 39. University of Toronto – Scarborough, Department of Biology (2007)
 40. Georgia State University, Department of Biology (2007)
 41. Emory University, Department of Psychology (2007)

42. Washington University in St. Louis, Department of Biology (2007)
43. University of Oklahoma, Department of Zoology (2007)
44. Central Connecticut State University, Department of Biology (2006)
45. University of Victoria, Department of Biology (2006)
46. University of Virginia, Department of Biology (2002)
47. 6th International Congress of Neuroethology; Vancouver, Canada; Satellite Meeting: Neurobiology of Electrosensory Organisms (2001)

SUBMITTED MEETING PRESENTATIONS

1. Vélez A, Ryoo D and Carlson BA (2016) Localization of Electric Communication Signals Varies with Electroreceptor Anatomy in Mormyrid Fishes. **53rd Annual Conference of the Animal Behavior Society**. Columbia, MO.
2. Sukhum K, Freiler M, Wang R and Carlson BA (2016) The evolution of extreme encephalization results in higher energetic demand and reduced hypoxia tolerance in weakly electric African fishes (Mormyridae). **Evolution 2016**. Austin, TX.
3. Vélez A and Carlson BA (2016) Transient synchrony across oscillating receptors results in time-locked evoked potentials in the central electrosensory system of weakly electric fish. **12th International Congress of Neuroethology**. Montevideo, Uruguay.
4. Vélez A, Kohashi T and Carlson BA (2016) What is the neural basis of evolutionary change in sensory perception? A case study in weakly electric fish. **12th International Congress of Neuroethology**. Montevideo, Uruguay.
5. Vélez A, Kohashi T and Carlson BA (2015) Similar changes in neuronal circuitry mediate parallel evolutionary change in sensory perception of communication signals in weakly electric fish. **J.B. Johnston Club for Evolutionary Neuroscience**. Chicago, IL.
6. Kohashi T and Carlson BA (2015) A fast BK-type KCa current acts as a postsynaptic modulator of temporal selectivity for communication signals. **38th Annual Meeting of the Japan Neuroscience Society**. Kobe, Japan.
7. Baker CA, Ma X and Carlson BA (2014) Spike-timing-dependent plasticity shapes interval selectivity of electrosensory midbrain neurons. **Society for Neuroscience**. Washington, DC.
8. Baker CA, Huck K and Carlson BA (2014) Evolutionary divergence in peripheral sensory coding strategies in mormyrid weakly electric fishes. **J.B. Johnston Club for Evolutionary Neuroscience**. Washington, DC.
9. Sukhum K, Freiler M, Wang R and Carlson BA (2014) The costs of extreme encephalization: Bigger brains result in increased energetic demand and reduced hypoxia tolerance in weakly electric African fishes. **J.B. Johnston Club for Evolutionary Neuroscience**. Washington, DC.
10. Kohashi T, Yang J, Roberts-Gaddipati P and Carlson BA (2014) Pauses during communication release behavioral habituation through recovery from synaptic

- depression. **11th International Congress of Neuroethology**. Sapporo, Japan.
11. Baker CA, Huck K and Carlson BA (2014) Phase and amplitude modulations of oscillatory sensory receptors mediate detection of high-frequency group communication signals in an electric fish. **11th International Congress of Neuroethology**. Sapporo, Japan.
 12. Baker CA, Ma L, Casareale CR and Carlson BA (2013) Behavioral and single-neuron sensitivity to millisecond timing variations in communication signals of weakly electric fish. **Society for Neuroscience**. San Diego, CA.
 13. Kohashi T and Carlson BA (2013) Calcium-dependent potassium currents shape temporal selectivity for communication signals in mormyrid electric fish. **Society for Neuroscience**. San Diego, CA.
 14. Baker CA and Carlson BA (2013) Evolutionary divergence in peripheral sensory coding strategies in mormyrid weakly electric fish. **J.B. Johnston Club for Evolutionary Neuroscience**. San Diego, CA.
 15. Kohashi T and Carlson BA (2013) 'Pauses' during communication increase signal detectability through synaptic depression. **J.B. Johnston Club for Evolutionary Neuroscience**. San Diego, CA.
 16. Lyons-Warren AM, Kohashi T, Mennerick S and Carlson BA (2013) Processing submillisecond timing differences in a model electrosensory system. **ASCI/AAP Joint Meeting**. Chicago, IL.
 17. Fedrigo O, Nielsen WJ and Carlson BA (2012) Comparative transcriptome analysis of increased encephalization in mormyrid fishes. **Society for Molecular Biology and Evolution**. Dublin, Ireland.
 18. Braun CB, Carlson BA, Alves-Gomes JA (2012) Phylogenetic diversity of responses to jamming stimuli in pulse gymnotiforms: The evolution of smooth frequency shifts. **Electric Fishes: Neural Systems, Behavior and Evolution**, Satellite to the 10th International Congress of Neuroethology. College Park, MD.
 19. Kohashi T, Ma X and Carlson BA (2012) Passive and active membrane properties contribute to temporal selectivity for communication signals in mormyrid electric fish. **10th International Congress of Neuroethology**. College Park, MD.
 20. Baker CA, Ma X and Carlson BA (2012) Differences in short-term synaptic depression of excitatory and inhibitory pathways contribute to temporal pattern recognition. **10th International Congress of Neuroethology**. College Park, MD.
 21. Lyons-Warren AM, Kohashi T, Mennerick S and Carlson BA (2012) It's not a coincidence: A novel mechanism for processing submillisecond spike timing differences. **10th International Congress of Neuroethology**. College Park, MD.
 22. Kohashi T and Carlson BA (2011) A novel whole-brain preparation for studying precise temporal coding in mormyrid electric fish. **Mont-Saint-Hilaire Electric Fish Meeting**. Montreal, Canada.
 23. Lyons-Warren AM and Carlson BA (2011) Tuning in to duration: Diversity in receptor

frequency tuning establishes a peripheral population code for stimulus duration.
Mont-Saint-Hilaire Electric Fish Meeting, Montreal, Canada.

24. Kohashi T and Carlson BA (2011) A novel whole-brain preparation for studying precise temporal coding in mormyrid electric fish. **Gordon Research Conference in Neuroethology: Behavior, Evolution & Neurobiology**. Easton, MA.
25. Lyons-Warren AM, Kohashi T, Mennerick S and Carlson BA (2011) Novel intensity-dependent re-coding of submillisecond spike timing differences. **J.B. Johnston Club for Evolutionary Neuroscience**. Washington, DC.
26. Lyons-Warren AM, Kohashi T, Mennerick S and Carlson BA (2011) A novel mechanism for processing submillisecond spike timing differences revealed through fluorescence guided in vivo recordings. **Society for Neuroscience**. Washington, DC.
27. George AA, Lyons-Warren AM and Carlson BA (2010) GABAergic inhibition shapes interpulse interval tuning in the electrosensory system of mormyrid electric fish. **9th International Congress of Neuroethology**. Salamanca, Spain.
28. Carlson BA, Hasan SM, Hollmann M and Arnegard ME (2010) Signal diversification drives the evolution of novel patterns of brain organization. **J.B. Johnston Club for Evolutionary Neuroscience**. San Diego, CA.
29. Hasan SM and Carlson BA (2009) Evolution of a sensory pathway mediating social communication behavior in mormyrid electric fish. **Society for Neuroscience**. Chicago, IL.
30. Lyons-Warren AM and Carlson BA (2009) Longer pulses are more electrifying: Pulse duration sensitivity in the mormyrid Knollenorgan electrosensory pathway. **Society for Neuroscience**. Chicago, IL.
31. Carlson BA (2008) Temporal-pattern recognition based on rate-dependent excitation and rate-dependent inhibition. **Society for Neuroscience**. Washington, DC.
32. Swanson M, Reshanov A, Carlson BA, Alves-Gomes JA and Braun CB (2008) Behavioral responses to potentially jamming signals in pulse-discharging gymnotiform fishes. **Society for Neuroscience**. Washington, DC.
33. Carlson BA and Kawasaki M (2008) An Information theoretical approach to parallel sensory pathways in weakly electric fishes. **Sensors and Sensing in Biology and Engineering**. Calabria, Italy.
34. Carlson BA and Kawasaki M (2007) Illusion or adaptation? Electrical behaviors induced by phantom stimuli. **8th International Congress of Neuroethology**. Vancouver, British Columbia.
35. Carlson BA (2007) Temporal-pattern sensitivity in the mormyrid electric communication pathway. **8th International Congress of Neuroethology**. Vancouver, British Columbia.
36. Carlson BA and Kawasaki M (2005) Parallel processing of multiple stimulus parameters and the emergence of combination sensitivity. **Computational and Systems Neuroscience**. Salt Lake City, UT.

37. Carlson BA and Kawasaki M (2005) Ambiguous encoding of multiple stimulus parameters in weakly electric fish. **Computational Neuroscience Meeting**. Madison, WI.
38. Carlson BA and Kawasaki M (2005) Combination sensitivity in *Gymnarchus niloticus* results from the temporal dynamics of excitation and inhibition. **Society for Neuroscience**. Washington, DC.
39. Arnegard ME and Carlson BA (2004) Electrolocation and electrical communication during pack-hunting in *Mormyrops anguilloides*. **7th International Congress of Neuroethology**. Nyborg, Denmark.
40. Carlson BA and Kawasaki M (2004) Non-linear response properties of combination-sensitive electrosensory neurons in the midbrain of *Gymnarchus niloticus*. **7th International Congress of Neuroethology**. Nyborg, Denmark.
41. Carlson BA and Hopkins CD (2002) Two motor control centers for social communication displays in mormyrid electric fish. **Society for Neuroscience**. Orlando, FL.
42. Carlson BA and Hopkins CD (2001) Electrical stimulation of descending electromotor nuclei in the mormyrid *Brienomyrus brachyistius* and the control of electric signaling behavior. **6th International Congress of Neuroethology**. Bonn, Germany.
43. Carlson BA and Hopkins CD (2000) Neural mechanisms in the generation of electric signals in mormyrid fish. **Society for Neuroscience**. New Orleans, LA.
44. Carlson BA and Hopkins, CD (1998) Socially-mediated changes in the electric organ discharge of a mormyrid fish. **5th International Congress of Neuroethology**. San Diego, CA.
45. Carlson BA and Nolen TG (1997) Defensive ink of *Aplysia* activates dactyl chemoreceptors of the predatory crab *Cancer*. **Society for Neuroscience**. New Orleans, LA.