BIOGRAPHICAL SKETCH

NAME: Ruilong Hu

eRA COMMONS USER NAME: ruilonghu

POSITION TITLE: Graduate Student

EDUCATION/TRAINING:

INSTITUTION AND LOCATION	DEGREE	START DATE	END DATE	FIELD OF STUDY
Washington University in St. Louis	BA	2007	2011	Cognitive Neuroscience
University of Maryland	PhD	2013	--	Sensory Neurobiology

A. Personal Statement

My research passion is to understand the cellular and physiological mechanisms by which human diseases disrupt physiology and proper formation of neural circuits. During my undergraduate training at Washington University in St. Louis, my research in Dr. Jeff Gidday's lab centered on investigating the molecular mechanisms by which hypoxic preconditioning provides ischemic tolerance to stroke, in which I learned techniques such as immunohistochemistry and confocal microscopy. As an undergraduate summer researcher with Dr. Stephen Shea at Cold Spring Harbor Laboratory, I had the opportunity to complement this molecular work, with *in vivo* single unit electrophysiology in mouse auditory cortex to investigate the functional circuitry underlying pup call discrimination. Following my undergraduate studies, I was a research technician in Dr. Camillo Padoa-Schioppa's lab at Washington University School of Medicine where I acquired expertise in behavioral neuroscience by training non-human primates to perform an economic decision-making task and performed single unit recordings in the orbitofrontal cortex. These important research experiences drove me to pursue a PhD in Neuroscience where I could study circuit physiology in the context of behavior. I chose Dr. Ricardo Araneda's lab at the University of Maryland because of his multiple levels of approaching neuromodulation in sensory circuits. My PhD research focuses on physiological mechanisms for cell-intrinsic and -extrinsic regulation of inhibition in olfactory circuits, as well as top-down control of olfactory processing by neuromodulators. In addition, throughout graduate school, I have devoted significant efforts in training young scientists, specifically teaching students from backgrounds underrepresented in science how to code in MATLAB and Python, and I plan to continue these important mentorship opportunities throughout my career.

B. Academic Positions

ACTIVITY/ OCCUPATION	START DATE	END DATE	FIELD	INSTITUTION/ COMPANY	SUPERVISOR/ EMPLOYER
Undergraduate Researcher	01/2008	05/2011	Stroke Neurobiology	Washington University, St. Louis, MO	Jeff Gidday, PhD
Summer Undergraduate Research Fellow	06/2010	08/2010	*In vivo* neurophysiology: rodents	Cold Spring Harbor Laboratory, NY	Stephen Shea, PhD
Research Technician	09/2011	07/2013	*In vivo* neurophysiology: primates	Washington University, St. Louis, MO	Camillo Padoa-Schioppa, PhD
Electrophysiology Teaching Fellow	Summer 2014	Summer 2019	Neurobiology	Marine Biological Laboratory, Wood Hole, MA	Neurobiology Course: Diana Bautista, PhD & Ellen Lumpkin, PhD
Lab Instructor	08/2014	Present	Undergraduate Neurophysiology Lab	UMD, College Park	Hilary Bierman, PhD
PhD Candidate	2013	Present	Sensory Neurophysiology	UMD, College Park	Ricardo Araneda, PhD

Academic and Professional Honors/Awards

2018-2019 Ann G. Wylie Dissertation Fellowship, UMD
2018-2019 Outstanding Research Assistant Award, UMD
2019 Jacob K. Goldhaber Grant, Society for Neuroscience Travel Award, UMD
2018 Cosmos Scholar, Cosmos Club Foundation
2015-2018 National Science Foundation Graduate Research Fellowship
2014, 2017 NACS Travel Award, UMD
2015 AChemS Travel Fellowship Award, Association for Chemoreception Sciences
2014, 2015 Dean's Fellowship Summer Award, UMD
2008 Howard Hughes Medical Institute Research Grant, WUSTL

Professional Activities

Professional Membership: Society for Neuroscience (Washington D.C Chapter Member), Association for Chemosensory Sciences
Ad-Hoc Journal Reviewer: Journal of Visualized Experiments

Other Academic Experiences

2017-2019 Hosting Skill Development Workshops: Intro to Programming in MATLAB Workshop (for graduate students), Monthly Methodology Seminars (for graduate students)

2014-2019 Guest Lecturing (Graduate and Undergraduate Classes)**:** Topics in Neuroscience, Biology of Chemosensory Systems, Neural Systems and Behavior

2014-2019 Undergraduate Mentoring: Allison Arai, UMD Medical School, MD-PhD Program; Wilson Chan, PSU Medical School; Taj Keshav, John Hopkins School of Public Health; Andre DeSouza, UCSD Neurobiology PhD Program; Grant Dong, Integrated Life Sciences, UMD; Peter Marston, Integrated Life Sciences, UMD

2014-2019 High School Mentoring and UMD Outreach*:* Matthew Kegley, Yale; Rose Pierce, U Chicago; Sarah Leonard, Swarthmore; Amaka Emerson, UMBC

C. Contributions to Science

I. Extrinsic and intrinsic regulation of inhibition in the olfactory bulb: Inhibitory interneurons in the OB outnumber principal excitatory neurons 500:1 and are crucial for olfactory function. Among the most prominent inhibitory neurons of the OB are the granule cells (GCs), which inhibit the sole output of the OB. State-dependent regulation by long-range neuromodulatory projections can work in concert with intrinsic physiological properties such as ionic conductances to regulate inhibition in the OB and olfactory processing. For my graduate thesis, I am elucidating cellular and physiological mechanisms by which inhibition in the OB is regulated by intrinsic and extrinsic factors. Among intrinsic factors, I characterized the hyperpolarization-activated cyclic nucleotide gated conductance (I_h) in GCs. Because these neurons undergo neurogenesis throughout life, I characterized how I_h changed in these cells and found increase in electrical resonance as they integrated into an existing circuit. These findings provided a cellular mechanism for how GCs may differentially participate in the circuit as a function of cell age. Noradrenergic modulation from the locus coeruleus plays a crucial role in shaping sensory perception as a function of physiological arousal and alertness. Using whole-cell patch clamp electrophysiology, I am providing a comprehensive model of noradrenergic modulation and its effect on OB circuit physiology. I have characterized how noradrenaline (NA) affects primary interneuron subtypes in the OB across the different layers, as well as its effects on the output of the OB's principal neurons. Finally, noradrenaline acts on GPCRs to regulate intracellular signaling cascades, therefore I am currently examining the control of GC excitability and dendritic processing by α_2 - adrenergic receptor regulation of I_h via intracellular cAMP. These studies aim to present a detailed mechanistic explanation for how noradrenergic modulation can alter inhibitory interneuron physiology to affect their roles in circuit processing.

Journal Publications

Hu R, Ferguson KA, Whiteus CB, Meijer DH, Araneda RC (2016). "Hyperpolarization-activated currents and subthreshold resonance in granule cells of the olfactory bulb." eNeuro 3.5: ENEURO-0197.

Hu R, Arai AL, Schneider KN, Araneda RC (in preparation). "Layer-specific noradrenergic modulation between the main and accessory olfactory bulbs"

Hu R, Villar PS, Dong GZ, Araneda RC (in preparation). "α_2 - adrenergic modulation of I_h in adult-born granule cells and circuit physiology in the olfactory bulb"

Published Abstracts and Presentations

Society for Neuroscience, San Diego, CA, 2018
"Adrenergic modulation of I_h in adult-born granule cells of the olfactory bulb"

Society for Neuroscience, Washington, DC, 2017
"Neuron-specific noradrenergic modulation between the main and accessory olfactory bulb"

Society for Neuroscience, Chicago, IL, 2015
"Hyperpolarization-activated currents and subthreshold resonance in granule cells of the olfactory bulb"
Association for Chemoreception Sciences, Bonita Springs, FL, 2015
"Hyperpolarization-activated currents in granule cells of the olfactory bulb"

II. **Modulation of olfactory circuits and behavior by the basal forebrain:** State-dependent cholinergic and GABAergic modulation of brain circuits is critical for several high-level cognitive functions, including attention and memory. One area of my graduate research has focused on the control of OB circuit dynamics by basal forebrain long-range neuromodulatory neurons. My work provided direct evidence that interneurons in the OB are regulated by cholinergic neurons in the basal forebrain and that disrupting this inhibition deleteriously affects odor discrimination. Furthermore, I designed and implemented an olfactory social learning task that utilizes the resident-intruder paradigm in the context of social defeat to study the role of cholinergic modulation on social behaviors. By implementing an automated post-hoc video-tracking software in MATLAB combined with DREADDS, I provided evidence that long-range cholinergic afferent modulation is necessary for social odor learning. In addition to the cholinergic centers in the basal forebrain, there are long-range GABAergic projections to the OB from the magnocellular preoptic nucleus (MCPO). My NSF-GRFP project focuses on examining the contributions of these projections in the context of *in vivo* physiology and behavior. Currently, I am performing local field potential recordings in the OB when activating or inactivating these GABAergic afferents with ChR2 or ArchT to study their influence on OB gamma oscillations. In addition, I am developing a real-time mouse-tracking software in MATLAB to track the body and head position to implement closed-loop optogenetics with the purpose of probing the role of these GABAergic afferents in olfactory investigation behaviors.

Journal Publications

Smith RS, **Hu R**, Chan W, Desouza A, Araneda RC (2015). "Cholinergic Modulation in the Olfactory Bulb" J.Neurosci. 35:10773-85

Villar PS, **Hu R**, Lantz CL, Quinlan EM, Araneda RC (in preparation). "Regulation of inhibitory circuit dynamics by long-range GABAergic transmission from the basal forebrain"

Published Abstracts and Presentations

Society for Neuroscience, Washington DC, 2017
"Regulation of basal forebrain GABAergic transmission in the olfactory bulb"

III. **Cellular and molecular mechanisms in ischemic tolerance following hypoxic preconditioning:** A stressful, but not damaging stimulus, can be used to precondition an organism for protection against subsequent injury by initiating endogenous signaling mechanisms. In the lab of Dr. Jeff Gidday at Washington University School of Medicine, I utilized immunohistochemistry and confocal microscopy to characterize the expression of various immune signaling molecules, such as CCL2 and CXCL12, and examine the time course of cell-specific expression after hypoxic preconditioning and after induction of stroke. Disruption of the blood brain barrier and infiltration of leukocytes to the brain parenchyma contributes to brain injury following stroke and my experiments demonstrated that CXCL12 expression on microvessels, following hypoxic preconditioning, contributed to the maintenance of blood brain barrier integrity post-stroke. Furthermore, I showed that that blockade of CXCL12 receptors abolished the protective effects of hypoxic preconditioning.

This work elucidated key signaling mechanisms for understanding the molecular mechanisms involved in the protective effects of hypoxic preconditioning and blood brain barrier protection.

Journal Publications

Selvaraj UM, Ortega SB, **Hu R**, Gilchrist R, Kong X, Partin A, Plautz EJ, Klein RS, Gidday JM, Stowe AM (2016). "Preconditioning-induced CXCL12 upregulation minimizes leukocyte infiltration after stroke in ischemia-tolerant mice." Journal of Cerebral Blood Flow & Metabolism. 37 (3): 801-813

Stowe AM, Wacker BK, Cravens PD, Perfater JL, Li MK, **Hu R**, Freie A, Stüve O, & Gidday JM (2012). "CCL2 upregulation triggers hypoxic preconditioning-induced protection from stroke." Journal of Neuroinflammation. 9 (33)

Published Abstracts and Presentations

6th International Symposium on Neuroprotection & Neurorepair, Rostock, Germany, 2010
"Promoting endogenous protective mechanisms at the blood-brain barrier to reduce neurovascular inflammatory injury following stroke"

XXIVth International Symposium on Cerebral Blood Flow, Metabolism, and Function, Chicago, IL, 2009
"The anti-inflammatory chemokine, CXCL12, and its receptor CXCR4, in hypoxic preconditioning: expression changes and cell-specific roles in establishing ischemic tolerance "

Society of Neuroscience, Chicago, IL, 2009
"Repetitive hypoxic preconditioning increases CXCL12 expression at the blood-brain barrier and induces angiogenesis prior to stroke"