

AUSTIN FERRO PhD

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EDUCATIONAL BACKGROUND

PERSONAL STATEMENT

I am a highly motivated researcher with expertise in both molecular and functional physiological neuroscience and a love for mentorship. I am interested in the cellular diversity of the brain and how the milieu of both neurons and glia form functional circuits. Particularly, my research aims to describe how glia coordinate and interact with neurodevelopment and adult brain function. Addressing how these cell types interact throughout life will not only lead to better understanding of normal brain function, but may also elucidate glial-based therapeutic targets for neuropsychiatric and neurodegenerative diseases. To this aim, I have discovered how microglia and oligodendrocyte precursor cells (OPCs) coordinate visual cortical development. In the future, as an independent investigator, my research will focus on determining if these interactions go awry in neurodevelopmental disorders and their contributions to neuropathophysiology.

POSTDOCTORAL RESEARCH EXPERIENCE

Postdoctoral Fellow (2020-Present). Dr. Lucas Cheadle's laboratory, Cold Spring Harbor Laboratory (CSHL), Cold Spring Harbor, NY. Determining the function of microglia and oligodendrocyte precursor cells (OPCs) during sensory experience-dependent visual circuit development as well as in the adult.

In Dr. Lucas Cheadle's lab, I have been investigating the roles of glia in development and in the adult. In particular, I have been focusing on two main projects: 1) the role of the microglial-neuron cytokine signalling axis TWEAK-Fn14 in normal brain function (**Ferro** et al., *BioRxiv*) and 2) the role of microglia and OPCs in

visual circuit development and adult function (Auguste*, **Ferro***, et al., 2022). I am continuing this research now to determine how microglia-OPC interactions affect downstream neuron-OPC synapse physiology.

GRADUATE RESEARCH EXPERIENCE

PhD Candidate (2015-2020). Laboratories of Drs. Marija Cvetanovic and Alfonso Araque. University of Minnesota, Minneapolis, MN. Identification of disease modifying functions of glia in spinocerebellar ataxia type 1 (SCA1).

During my PhD work, I investigated and identified potential roles of both microglia (Ferro et al., 2018, Ferro et al., 2019a, Ferro et al., 2019b) and astroglia (in preparation) in the pathogenesis of SCA1. To characterize the function of glia in SCA1, I combined molecular, morphological, and electrophysiological characterization alongside genetic modifications of mouse models in SCA1.

To develop my thesis work, I was awarded a Ruth L. Kirschstein National Research Service Award (NRSA) (F31NS103392) by the NIH National Institute of Neurological Disease and Stroke. My NRSA entitled; Bimodal function of astroglia in SCA1, funded my stipend and tuition between 2018-2020.

ACQUIRED LAB SKILLS:

- Patch-clamp electrophysiology
- Synaptic physiology
- PCR/ qPCR
- Western blotting
- Glial physiology
- Cloning
- Graphic design
- Flow cytometry/ cell isolation
- Immunohistochemistry/ fluorescence
- Single/two photon microscopy
- Stereotaxic surgery
- Calcium imaging
- Mouse behavior
- In vivo* 2 photon microscopy

HONORS AND AWARDS

2018	1 st place poster winner Wallin Neuroscience Discovery Day, University of Minnesota
2018	Hot Chair travel grant, National Ataxia Foundation
2018	F31 NS103392-01A1, NIH
2018	Sping and Ying Ngoh Lin Award for Research Independence
2018	NAF Young Investigator grant, National Ataxia Foundation
2017	Stark Award, University of Minnesota.
2015	Faculty for Undergraduate Research Travel Award, Skidmore College.
2015	Hartnett Prize for Undergraduate Research, Skidmore College.
2015	Student Opportunity Fund- Travel to Present, Skidmore College.
2014	Student Opportunity Fund- Travel to Present, Skidmore College.
2014	Summer Collaborative Research Grant, Skidmore College.
2013	Top finalist in the Student Poster Competition at the Neurotrauma Symposium, Roskamp Institute.
2013	Summer Collaborative Research Grant, Skidmore College.

PUBLISHED MANUSCRIPTS

* Authors contributed equally

1. Auguste, Y.S.*, **Ferro, A***., Kahng, J.A., Xavier, A.M., Dixon, J.R., Vrudhula, U., Nichitiu, A.S., Rosado, D., Wee, T.L., Pedmale, U.V. and Cheadle, L., 2022. Oligodendrocyte precursor cells engulf synapses during circuit remodeling in mice. *Nature Neuroscience*, 25(10), pp.1273-1278.

2. **A. Ferro**, L. Cheadle, When the levee of sympathetic outflow breaks. *Immunity*. 55, 1334–1336 (2022).
3. **A. Ferro**, Y. S. S. Auguste, L. Cheadle, Microglia, Cytokines, and Neural Activity: Unexpected Interactions in Brain Development and Function. *Front. Immunol.* 12, 2546 (2021).
4. **A. Ferro**, C. Sheeler, M. Cvetanovic, Microglial Self-Recognition STINGs in A-T Neurodegeneration. *Trends Neurosci.* 42 (2019), pp. 753–755.
5. **A. Ferro**, C. Sheeler, J. G. Rosa, M. Cvetanovic, Role of Microglia in Ataxias. *J. Mol. Biol.* 431 (2019), pp. 1792–1804.
6. A. Mellesmoen, C. Sheeler, **A. Ferro**, O. Rainwater, M. Cvetanovic, Brain Derived Neurotrophic Factor (BDNF) Delays Onset of Pathogenesis in Transgenic Mouse Model of Spinocerebellar Ataxia Type 1 (SCA1). *Front. Cell. Neurosci.* 12, 509 (2019).
7. **A. Ferro**, W. Qu, A. Lukowicz, D. Svedberg, A. Johnson, M. Cvetanovic, Inhibition of NF-κB signaling in IKK β F/F;LysM Cre mice causes motor deficits but does not alter pathogenesis of Spinocerebellar ataxia type 1. *PLoS One*. 13 (2018), doi:10.1371/journal.pone.0200013.
8. **A. Ferro**, E. Carbone, J. Zhang, E. Marzouk, M. Villegas, A. Siegel, D. Nguyen, T. Possidente, J. Hartman, K. Polley, M. A. Ingram, G. Berry, T. H. Reynolds, B. Possidente, K. Frederick, S. Ives, S. Lagalwar, Short-term succinic acid treatment mitigates cerebellar mitochondrial OXPHOS dysfunction, neurodegeneration and ataxia in a Purkinje-specific spinocerebellar ataxia type 1 (SCA1) mouse model. *PLoS One*. 12, e0188425 (2017).
9. **A. Ferro**, E. Carbone, E. Marzouk, A. Siegel, D. Nguyen, K. Polley, J. Hartman, K. Frederick, S. Ives, S. Lagalwar, S. Treating SCA, Treating SCA1 Mice with Water - Soluble Compounds to Non - Specifically Boost Mitochondrial Function Video Link. *J. Vis. Exp.* 119 (2017), doi:10.3791/53758.
10. B. C. Mouzon, C. Bachmeier, **A. Ferro**, J.-O. Ojo, G. Crynen, C. M. Acker, P. Davies, M. Mullan, W. Stewart, F. Crawford, Chronic neuropathological and neurobehavioral changes in a repetitive mild traumatic brain injury model. *Ann. Neurol.* 75, 241–254 (2014).
11. L. Abdullah, J. E. Evans, A. Bishop, J. M. Reed, G. Crynen, J. Phillips, R. Pelot, M. A. Mullan, **A. Ferro**, C. M. Mullan, M. J. Mullan, G. Ait-Ghezala, F. C. Crawford, Lipidomic Profiling of Phosphocholine Containing Brain Lipids in Mice with Sensorimotor Deficits and Anxiety-Like Features After Exposure to Gulf War Agents. *NeuroMolecular Med.* 14, 349–361 (2012).

PUBLISHED ABSTRACTS AND POSTERS

1. **A. Ferro**, L. Cheadle. Microglia coordinate OPC-Synapse Interactions. Talk at 2024 CSHL Glia, Cold Spring Harbor, NY. Presented by **A. Ferro**
2. **A. Ferro**, L. Cheadle. Exploring microglia-OPC interactions and their implications for circuit development and function. Talk at CSHL In-House, Cold Spring Harbor, NY. Presented by **A. Ferro**
3. **A. Ferro**, L. Cheadle. Exploring microglia-OPC interactions and their implications for circuit development and function. Poster at 2024 Myelin GRC, Ventura, CA. Presented by **A. Ferro**
4. **A. Ferro**, Y. Auguste, J. Dixon, J. Kahng, A. Machado, U. Vrudhula, A-Nichitiu, L. Cheadle. Oligodendrocyte precursor cells participate in sensory-dependent synaptic refinement through engulfment of synapses. Poster at 2023 Glia GRC, Ventura, CA. Presented by **A. Ferro**
5. **A. Ferro**, Y. Auguste, J. Dixon, J. Kahng, A. Machado, U. Vrudhula, A-Nichitiu, L. Cheadle. Oligodendrocyte precursor cells participate in sensory-dependent synaptic refinement through engulfment of synapses. Poster at 2022 Neurodevelopment GRC, Newport, RI. Presented by **A. Ferro**
6. **A. Ferro**, Y. Auguste, J. Dixon, J. Kahng, A. Machado, U. Vrudhula, A-Nichitiu, L. Cheadle. Oligodendrocyte precursor cells participate in sensory-dependent synaptic refinement through engulfment of synapses. Poster at 2022 Neurodevelopment GRS, Newport, RI. Presented by **A. Ferro**
7. **A. Ferro**, Y. Auguste, J. Dixon, J. Kahng, A. Machado, U. Vrudhula, A-Nichitiu, L. Cheadle. Oligodendrocyte precursor cells participate in sensory-dependent synaptic refinement through engulfment of synapses. Poster at 2022 Glia in Health and Disease, Cold Spring Harbor, NY. Presented by **A. Ferro**
8. **A. Ferro**, J. Kim, A. Araque, M. Cvetanovic. Biphasic function of Bergmann glia in SCA1. Poster at 2020 National Ataxia Foundation Investigators Meeting, Denver, CO. Presented by **A. Ferro**

9. **A. Ferro**, J. Kim, A. Araque, M, Cvetanovic. Biphasic function of Bergmann glia in SCA1. Cerebellar Mechanisms for Movement, Learning and Cognition in Health and Disease, Les Diablerets (Switzerland). Presented by **A. Ferro**
10. **A. Ferro**, A. Araque, Marija Cvetanovic. Bimodal function of Bergmann glia in SCA1 disease progression. Poster at Annual Graduate Program in Neuroscience Retreat, Minneapolis, MN. Presented by **A. Ferro**
11. **A. Ferro**, J. Kim, A. Araque, M, Cvetanovic. Biphasic function of Bergmann glia in SCA1. Poster at 3rd Annual Wallin Neuroscience Discovery day, Minneapolis, MN. Presented by **A. Ferro**
12. **A. Ferro**, J. Kim, A. Araque, M, Cvetanovic. Biphasic function of Bergmann glia in SCA1. Poster and Hot Chair talk at 2018 National Ataxia Foundation Investigators Meeting, Philadelphia, PA. Presented by **A. Ferro**
13. **A. Ferro**, A. Araque, Marija Cvetanovic. Bimodal function of Bergmann glia in SCA1 disease progression. Poster at Annual Graduate Program in Neuroscience Retreat, Minneapolis, MN. Presented by **A. Ferro**
14. **A. Ferro**, A. Araque, Marija Cvetanovic. Bimodal function of Bergmann glia in SCA1 disease progression. Talk at the 2017 International Astrocyte School, Bertinoro (Italy). Presented by **A. Ferro**
15. A. Siegle, **A. Ferro**, S. Lagalwar, K. Fredreich. Development and optimization of an ion-exchange HPLC method for quantification of succinic acid in cerebral tissue. Poster at American Chemical Society meeting, San Diego, CA.
16. **A. Ferro**, E. Carbone, J. Zhang, A. Siegel, M. Villegas, T. H. Reynolds, K. Frederick, S. Ives and S. Lagalwar. Mitochondrial OXPHOS dysfunction in Spinocerebellar ataxia type 1. Poster at 2015 Society for Neuroscience conference- FUN, Chicago. Presented by **A. Ferro**
17. **A. Ferro**, E. Carbone, J. Zhang, A. Siegel, M. Villegas, T. H. Reynolds, K. Frederick, S. Ives and S. Lagalwar. Mitochondrial OXPHOS dysfunction in Spinocerebellar ataxia type 1. Poster at 2015 Society for Neuroscience conference- Ataxias: Methods and Models, Chicago, IL. Presented by **A. Ferro**
18. **A. Ferro**, E. Carbone, J. Zhang and S. Lagalwar. Mitochondrial OXPHOS dysfunction in Spinocerebellar ataxia type 1. Poster at 2014 Society for Neuroscience conference- FUN, Washington D. C. Presented by **A. Ferro**
19. **A. Ferro**, J. Zhang, E. Carbone ,S. Lagalwar. Determining The Role of Mitochondria in SCA1 Progression. Poster at 2014 NY Six Undergraduate Research Conference, Albany, NY. Presented by **A. Ferro**
20. **A. Ferro**, J. Zhang, E. Carbone ,S. Lagalwar. Determining The Role of Mitochondria in SCA1 Progression. Poster at 2014 Capital Region Society for neuroscience conference, Albany, N.Y. Presented by **A. Ferro** and J. Zhang
21. E. Carbone, **A. Ferro** and S. Lagalwar. Mitochondrial OXPHOS dysfunction in Spinocerebellar ataxia type 1. Poster at 2014 National Ataxia Foundation Investigator's meeting, Las Vegas, NV.
22. E. Carbone, **A. Ferro** and S. Lagalwar. Mitochondrial OXPHOS dysfunction in Spinocerebellar ataxia type 1. Poster at 2014 NEURON conference, Quinnipiac University, CT. Presented by E. Carbone and **A. Ferro**
23. Tzekov, R., **Ferro**, A., Mouzon, B., Biggins, D., Spinelli, R., Mullan, M., Crawford, F. Optic nerve and inner retina damage after repeated mild traumatic brain injury in a mouse model. Abstract in *Investigative Ophthalmology and Visual Science*, 54(6), 1427.
24. E. Carbone, **A. Ferro**, J. Zhang, S. Lagalwar. Mitochondrial Dysfunction in Spinocerebellar Ataxia Type 1. Poster at 2013 Society for Neuroscience conference- Ataxias: Methods and Models, San Diego, C.A.
25. E. Carbone, **A. Ferro**, J. Zhang, S. Lagalwar. Mitochondrial Dysfunction in Spinocerebellar Ataxia Type 1. Poster at 2013 Society for Neuroscience conference- FUN session, San Diego, C.A.
26. B. Mouzon, G. Crynen, **A. Ferro**, C. Bachmeier, M. Mullan, F. Crawford, W. Stewart. Repetitive mild traumatic brain injury produces persistent memory deficits accompanied by chronic histological changes. Poster at 2013 Neurotrauma Symposium, Nashville, TE.

REVIEWER FOR:**-Neuroscience**

TEACHING, SERVICE AND MENTORING

Student Mentor (2020-Present). Laboratory of Dr. Lucas Cheadle. CSHL, Cold Spring Harbor, NY.

Uma Vrudhula- Cheadle Lab

Yohan Auguste- Cheadle Lab

Anne-Sarah Nichitiu- Partners for the Future scholar, 2021

Jessica Kahng- CSHL School of Biological Sciences PhD candidate, Entering class of 2020

Samantha Tang- Stony Brook University, Department of Neurobiology and Behavior PhD candidate, Entering class of 2021

Anosha Arshad- Stony Brook University, Department of Neurobiology and Behavior Masters Student, Graduated 2024

Aisha Ademola- Cheadle Lab

Patrick Werhle- Stony Brook University, Department of Neurobiology and Behavior PhD student, Entering class of 2023

Advised and mentored high school, undergraduate, and graduate students in various lab techniques, experimental design, coding, as well as grantsmanship. As a senior member in the Cheadle lab, I taught incoming students single photon and multiphoton microscopy techniques and analysis, coding, PCR and qPCR, cloning, surgery, fluorescent *in situ* hybridization, as well as mentored with writing and grantsmanship.

Guest Lecture (2019). Neuroscience concentration capstone course (NEUR395). Carleton College, Northfield, MN.

Student Mentor (2015-2020). Laboratories of Drs. Cvetanovic and Araque. University of Minnesota, Minneapolis, MN.

Katie Hammel- University of Minnesota GPN, Entering class of 2018

Jua Rosa- Cvetanovic Lab

Ella Borgenheimer- Cvetanovic Lab

Carlee Toddles- University of Minnesota GPN, Entering class of 2016

Nicole Zarate- University of Minnesota GPN, Entering class of 2017

Marietta Monteivero- Macalester College, Class of 2018

Jack Martin- Colorado College, Class of 2019

Advised and mentored both undergraduate and graduate students in various lab techniques, experimental design, coding, as well as grantsmanship. As a senior member in both the Cvetanovic and Araque labs I taught incoming students microscopy techniques and analysis, cerebellar slice electrophysiology, PCR and qPCR, calcium imaging, as well as mentored F31 grantsmanship.

Glia Journal Club President (2019). I direct a biweekly journal club dedicated to the function of Glia in healthy and pathological states. University of Minnesota, Minneapolis, MN.

Guest Lecturer (2018). Cellular Signaling in the Nervous System: The Old and New Players. Macalester College, St. Paul, MN.

Teaching Assistant (2017). Introduction to Neurobiology II: Perception and Behavior. University of Minnesota, Minneapolis, MN.

Student Mentor (2013-2015). Laboratory of Dr. Sarita Lagalwar. Skidmore College, Saratoga Springs, NY.

Chloe Larson- Skidmore College, Class of 2016

Jenny Zhang- Skidmore College, Class of 2016

Monica Villegas- Skidmore College, Class of 2016

Porter Hall- Skidmore College, Class of 2016

Annie Getz- Saratoga Springs High School, Class of 2016

Advised and mentored college students in various lab techniques as well as experimental design. As a mentor, I taught techniques such as western blotting, confocal microscopy, cell culture, transmission electron microscopy, pathology, and pharmacology to various people in the lab. Advised a high school student, Annie Getz, in designing a cell culture study to test over the counter herbicides on neuroblastoma cell development. In addition, I taught her techniques and mentored her on experimental design. Annie earned the Eleanor Miller Reed Science Research Award at the RPI Greater Capital Region Science Fair and submitted her work to the Science Intel-ISEF science competition.

UNDERGRADUATE RESEARCH EXPERIENCE

Research Student (2013-2015). Laboratory of Dr. Sarita Lagalwar. Skidmore College, Saratoga Springs, NY. Investigation of the role of mitochondria in SCA1 disease progression and identification of mitochondrial based treatments.

Using both cell and mouse models of SCA1, I identified mitochondrial dysfunction as a potential therapeutic target that could be ameliorated by succinic acid treatment (Ferro et al., 2017a, Ferro et al., 2017b). Methods included pharmacology, confocal immunofluorescence microscopy, OXPHOS activity assays, transmission electron microscopy, and behavioral paradigms such as accelerating rotarod. This research was developed into a senior thesis project at Skidmore College.

Summer Research Student (2013). Laboratory of Dr. Bernard Possidente. Skidmore College, Saratoga Springs, NY. Identification of transgenerational inheritance of lead poisoning and other stressors.

Parental lead exposure was found to cause transgenerational inheritance of increased motor behavior in Drosophila models that persisted into the third generation. We tested if this transgenerational inheritance of motor phenotype due to lead exposure would be translatable into mouse models. General activity, circadian rhythm, sleep and activity rhythms were measured in the transgenerational lead exposure mouse model using running wheel activity monitors, whereas the same parameters were measured in the Drosophila model using photo activity monitors. This work is ongoing in the Possidente lab.

Research Assistant (2011-2012). Supervisor: Dr. Fiona Crawford, Dr. Michael Mullan. Roskamp Institute, Sarasota, FL. Investigated brain pathology caused by a Gulf War Illness mouse model as well as a repeat traumatic brain injury (TBI).

I investigated brain pathology and behavior in response to both single and repetitive TBI in a human tau transgenic mouse model (Mouzon et al., 2014) as well as pathological responses to potential Gulf War illness agents (Abdullah et al., 2012). Behavioral work was performed using the Barnes maze to quantify spatial learning and pathology was quantified using immunohistology in combination with light microscopy in both studies.

EMPLOYMENT

Skidmore College (2014-2015). Job Description: Research Assistant. Saratoga Springs, NY.

Working for Dr. Lagalwar, my various duties included lab maintenance, organization, and upkeep for her research team (including myself) as well as her classes.

Roskamp Institute (2012). Job Description: Research Assistant. Sarasota FL.

My first year at Roskamp Institute, I worked as a volunteer until I was offered a paid position. Working for multiple PhD candidates and PhDs, I worked in both the pathology and behavior labs. My work consisted of

immunohistology, light microscopy, tissue fixation, and various behavioral paradigms including rotarod and Barnes maze.