**Mark S. Moehle, Ph.D.**

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**EDUCATION**

***Vanderbilt University - Nashville, TN*** 2015-2019

Postdoctoral Fellow

***University of Alabama at Birmingham – Birmingham, AL***  2010-2015

Ph.D. Neurobiology

***Centenary College of Louisiana – Shreveport, LA*** 2006-2010

B.S. Neuroscience – *cum laude*

**Professional Experience and Training**

***University of Florida*** 2020-Present

*Assistant Professor,* Department of Pharmacology & Therapeutics

***Vanderbilt University*** 2019-2020

Research Instructor, Department of Pharmacology

***Vanderbilt University*** 2015-2019

Postdoctoral Fellow, Department of Pharmacology (Mentor: Jeffrey Conn)

***University of Alabama at Birmingham*** 2010-2015

Graduate Fellow, Department of Neurology (Mentors: David Standaert & Andrew West)

**Louisiana State University Health Sciences Center** 2006-2010

Undergraduate Researcher, Department of Pharmacology (Mentor: Nicholas Goeders)

**GRANTS**

* M4 Muscarinic Acetylcholine Receptor Signaling as a Potent Regulator of Motor Deficits. NIH/NINDS K99NS110878 (2019-2024;**$909,000 in Direct Costs**)
* Antagonism of the M4 Receptor for Treatment of PD and PD-Dystonia. Michael J. Fox Foundation Target Advancement Program (2017-2018; **$90,909 in Direct Costs**)
* Muscarinic Receptor M4 Modulation of Dopaminergic Signaling in a GNAL Dystonia Mutant Mouse Model. Dystonia Medical Research Foundation. Mahlon DeLong Young Investigator Award (2016-2017 **$55,000 in Direct Costs**)
* Role of Microglial LRRK2 in Inflammation. NIH/NINDS F31NS081963 (2012-2015 *$****87,401 in Direct Costs***)

**HONORS & AWARDS**

* Elliot Newman Society Membership 2019
* Middle Tennessee Chapter of SFN Travel Award 2017
* Mahlon DeLong Young Investigator Award 2016-2017
* Awarded Position T32 MH093366 in CNS Drug Discovery 2015-2016
* Awarded Position T32 NS061788 in Cognition and Cognitive Disorders 2011-2012
* Howard Hughes Medical Institute UAB Med into Grad Fellow 2010-2015
* UAB Neuroscience Recruitment Fellowship 2010
* Sherwood Blue Memorial Scholarship 2009
* Centenary President’s Scholar 2006-2010

**PRESENTATIONS & ABSTRACTS (presenting author only)**

* **Moehle, MS,** Rook, JM, Foster, DJ, Yohn, SE, Niswender, CM, Jones, CK, Lindsley, CW, and Conn PJ. Selective M4 Muscarinic Acetylcholine Receptor Antagonists in Parkinsonian Motor Disability. **Poster.** Gordon Research Seminar on Parkinson’s Disease. (2019)
* **Moehle, MS,** Rook, JM, Foster, DJ, Yohn, SE, Niswender, CM, Jones, CK, Lindsley, CW, and Conn PJ. Selective M4 Muscarinic Acetylcholine Receptor Antagonists Relieve Specific Symptom Domains of Parkinsonian Motor Disability. **Poster.** Gordon Research Conference on Parkinson’s Disease. (2019)
* **Moehle, MS,** Rook, JM, Foster, DJ, Yohn, SE, Niswender, CM, Jones, CK, Lindsley, CW, and Conn PJ Selective antagonists of the M4muscarinic acetylcholine receptor relieve parkinsonian motor deficits.  **Poster.** 47th meeting of the Society for Neuroscience (2018)
* **Moehle, MS**, Pancani, T, Byun, N, Wilson III, GH, Dickerson, JW, Remke, DH, Xiang, Z, Niswender, CM, Wess, J, Jones, CK, Lindsley, CW, Rook, JM and Conn, PJ. Hindbrain cholinergic projections to the substantia nigra pars reticulata regulate direct pathway dopamine signaling. **Poster.** 47th meeting of the Society for Neuroscience (2017)
* **Moehle, MS**, Pancani, T, Byun, N, Wilson III, GH, Dickerson, JW, Remke, DH, Xiang, Z, Niswender, CM, Wess, J, Jones, CK, Lindsley, CW, Rook, JM and Conn, PJ. D1 activation in the SNr evokes GABA release and increased motor activity and is tonically inhibited by M4 receptor signaling. **Poster.** 46th meeting of the Society for Neuroscience (2016)
* **Moehle, MS,** Pancani, T, Byun, N., Xiang, Z., Wess, J., Rook, J.M., Niswender, C.M., Jones, C.K., Lindsley, C.W., and Conn, P.J. M4 muscarinic receptor activity opposes D1 dopamine receptor-evoked GABA release and motor activity in the SNr: Implications for M4 antagonists as a treatment for movement disorders. **Poster.** Parkinson’s World Congress (2016).
* **Moehle MS,** Daher JPL, and West AB. Pathogenic Mutations in LRRK2 Enhance Pro-Inflammatory Responses. Presentation. **Poster.** 44th meeting of the Society for Neuroscience (2014)
* **Moehle MS** and West AB. Pathogenic LRRK2 Mutations Lead to an Increased Pro-Inflammatory Response. **Poster**. Keystone Symposia on Parkinson’s Disease: Genetics, Mechanisms, and Therapeutics (2014)
* **Moehle MS,** Daher JPL, and West AB. LRRK2 regulates pro-inflammatory responses in macrophages. Poster. 42nd meeting of the Society for Neuroscience. **Poster**.(2012)
* **Moehle MS,** Butcher G, Guerin GF, and Goeders NE. Elucidating Mechanisms of Methamphetamine Related Aggression. **Poster**. 39th meeting of the Society for Neuroscience (2009)

**INVITED LECTURES**

* **Moehle, MS.** M4 Muscarinic Acetylcholine Receptor Regulation of the Basal Ganglia. **Invited Talk.** University of Florida Department of Pharmacology and Center for Translational Research in Neurodegeneration Seminar Series (2020)
* **Moehle, MS.** M4 Muscarinic Acetylcholine Receptor Regulation of the Basal Ganglia. **Invited Talk.** University of South Carolina Department of Pharmacology, Physiology, and Neuroscience Seminar Series (2020)
* **Moehle, MS.** M4 Muscarinic Acetylcholine Receptor Regulation of the Basal Ganglia. **Invited Talk.** University of South Carolina Department of Drug Discovery and Biomedical Sciences Seminar Series (2020)
* **Moehle, MS.** M4 Muscarinic Acetylcholine Receptor Regulation of the Basal Ganglia. **Invited Talk.** West Virginia University Department of Neuroscience Seminar Series (2020)
* **Moehle, MS.** M4 Muscarinic Acetylcholine Receptor Regulation of the Basal Ganglia. **Invited Talk.** University of Tennessee Health Sciences Center Department of Pharmaceutical Sciences Seminar Series (2020)
* **Moehle, MS.** M4 Muscarinic Acetylcholine Receptor Regulation of the Basal Ganglia. **Invited Talk.** Augusta University/Medical College of Georgia. Department of Neuroscience and Regenerative Medicine Seminar Series (2020)
* **Moehle, MS.** M4 Muscarinic Acetylcholine Receptor Regulation of the Basal Ganglia. **Invited Talk.** University of Alabama at Birmingham Department of Neurology/CNET Seminar Series (2019)
* **Moehle, MS,** Rook, JM, Foster, DJ, Yohn, SE, Niswender, CM, Jones, CK, Lindsley, CW, and Conn PJ. Selective M4 Muscarinic Acetylcholine Receptor Antagonists Relieve Parkinsonian Motor Disability. **Invited Talk.** Gordon Research Seminar on Parkinson’s Disease. (2019)
* **Moehle, MS and Conn, PJ.** M4 Muscarinic Acetylcholine Receptor Regulation of Striatal Function. **Invited Talk.** Vanderbilt University Basal Ganglia Working Group. (2019)
* **Moehle, MS.** Discovery of the first truly selective M4 antagonists: Implications for the treatment of Dystonia. **Invited Lecture.** Dystonia Medical Research Foundation, Targeted Drug Discovery Meeting (2018).
* **Moehle, MS and Conn, PJ.** Long Term Protective Effects of M4 Potentiation in Huntington’s Disease. **Invited Talk.** Vanderbilt University Basal Ganglia Working Group. (2018)
* **Moehle, MS** and Conn, PJ. M4 activity tonically inhibits the direct pathway: Implications for movement disorders. **Invited lecture.** Thiel College (2017)
* **Moehle, MS** and Conn, PJ. Muscarinic Receptor M4 Modulation of Dopaminergic Signaling in a GNAL Dystonia Mutant Mouse Model. **Invited Talk.** Dystonia Medical Research Foundation, Medical Science Advisory Council Meeting (2017).

**Professional and Academic Service**

* *Ad Hoc* Reviewer 2016-Present
  + *Neuroscience*
  + *Neuropsychopharmacology*
  + *Molecular and Cellular Neuroscience*
  + *Brain Research*
  + *Biomolecules*
  + *Frontiers in Neuroscience*
  + *Frontiers in Neruology*
* Grant Reviewer 2018-Present
  + Cures within Reach
  + Collaborative Center for X-Linked Dystonia-Parkinsonism
  + Dystonia Medical Research Foundation
  + Parkinson’s Disease Foundation
* Journal Club Leader - Electrophysiology Journal Club 2015-Present
* UAB Graduate Biomedical Sciences Admissions Committee 2013-2014
* UAB Neuroscience Admissions Committee 2011-2013

**Teaching and Mentorship**

* Mentor to:
  + Kinsey Bickham 2019-present
    - Current post-baccalaureate in the VCNDD
  + Christopher Price Withers 2018-present
    - Current Sophomore at Vanderbilt University
  + Augusto Diedrich 2018-present
    - Current Sophomore at Vanderbilt University
  + Randi Bruce 2016-2018
    - Current Law Student at Belmont University
  + Hemal Baghat 2012-2014
    - Current Medical student at UAB
  + Shelia Bhavsar 2011-2012
    - Current Medical Resident at UCSD
* Teaching Assistant, Molecular Mechanism of Memory 2012
* Teaching Assistant, Dauphin Island Sea Lab Course 2011

**PROFESSIONAL SOCIETIES**

***Society for Neuroscience*** 2007-Present

***American Association for the Advancement of Science*** 2010-2015

**PUBLICATIONS**

1. **Moehle, MS,** Yohn, SE, and Conn, PJ. Muscarinic Receptors in the Etiology and Treatment of Schizophrenia. *Psychosis*. Oxford University Press. Accepted
2. **Moehle, MS** and Conn, PJ. Roles of the M4 Acetylcholine Receptor in the Basal Ganglia and the Treatment of Movement Disorders. *Movement Disorders*. (2019) 10.1002/mds.27740 PMID 31211471
3. Yohn, SE, Foster, DJ, Covey, DP, **Moehle, MS**, et al. Activation of the mGlu1 metabotropic glutamate receptor has antipsychotic-like effects and is required for efficacy of M4muscarinic receptor allosteric modulators. *Molecular Psychiatry*. (2018) 10.1038/s41380-018-0206-2. PMID 30116027
4. **Moehle, MS**, Pancani, T, Byun, N, Yohn, SE, Wilson, GH, et al. Cholinergic Projections to the Substantia Nigra Pars Reticulata Inhibit Dopamine Modulation of Basal Ganglia through the M4 Muscarinic Receptor. *Neuron*. (2017) 20;96(6):1358-1372.e4. PMID: 29268098.
5. Walker AG, Sheffler DJ, Lewis AS, Dickerson JW, Foster DJ, Senter, RK, **Moehle, MS**, et al. Co-Activation of Metabotropic Glutamate Receptor 3 and Beta-Adrenergic Receptors Modulates Cyclic-AMP and Long-Term Potentiation, and Disrupts Memory Reconsolidation. *Neuropsychopharmacology*. (2017) 42(13):2553-2566. PMID: 28664928
6. Abdelmotilib H, Maltbie T, Delic V, Liu Z, Hu X, Fraser, KB, **Moehle, MS**, et al. α-Synuclein fibril-induced inclusion spread in rats and mice correlates with dopaminergic Neurodegeneration. *Neurobiology of Disease*. (2017) 105:84-98. PMID: 28576704
7. Fraser KB, **Moehle MS**, Alcalay RN, West AB. Urinary LRRK2 phosphorylation predicts parkinsonian phenotypes in G2019S LRRK2 carriers. *Neurology*. (2016) 15;86(11):994-9. PMID: 26865512
8. Pancani T, Foster DJ, **Moehle MS**, Bichell TJ, Bradley E, et al. Allosteric activation of M4 muscarinic receptors improve behavioral and physiological alterations in early symptomatic YAC128 mice. *Proceedings of the National Academy of Sciences*. (2015) 10;112(45):14078-83. PMID: 26508634
9. **Moehle MS**, West AB. M1 and M2 immune activation in Parkinson's Disease: Foe and ally?. *Neuroscience*. (2015) 27;302:59-73. PMID: 25463515
10. Daher JP, Abdelmotilib HA, Hu X, Volpicelli-Daley LA, **Moehle MS**, et al. LRRK2 Pharmacological Inhibition Abates α-Synuclein Gene-induced Neurodegeneration. *Journal of Biological Chemistry*. (2015) 7;290(32):19433-44. PMID: 26078453
11. **Moehle MS**, Daher JP, Hull TD, Boddu R, Abdelmotilib HA, et al. The G2019S LRRK2 mutation increases myeloid cell chemotactic responses and enhances LRRK2 binding to actin-regulatory proteins. *Human Molecular Genetics*. (2015) 1;24(15):4250-67. PMID: 25926623
12. Boddu R, Hull TD, Bolisetty S, Hu X, **Moehle MS**, et al. Leucine-rich repeat kinase 2 deficiency is protective in rhabdomyolysis-induced kidney injury. *Human Molecular Genetics*. (2015) 15;24(14):4078-93. PMID: 25904107
13. Liu Z, Galemmo RA Jr, Fraser KB, **Moehle MS**, Sen S, et al. Unique functional and structural properties of the LRRK2 protein ATP-binding pocket. *Journal of Biological Chemistry*. (2014) 21;289(47):32937-51. PMID: 25228699
14. West AB, Cowell RM, Daher JP, **Moehle MS**, Hinkle KM, et al. Differential LRRK2 expression in the cortex, striatum, and substantia nigra in transgenic and nontransgenic rodents. *Journal of Comparative Neurology*. (2014) 1;522(11):2465-80. PMID: 24633735
15. Daher JP, Volpicelli-Daley LA, Blackburn JP, **Moehle MS**, West AB. Abrogation of α-synuclein-mediated dopaminergic neurodegeneration in LRRK2-deficient rats. *Proceedings of the National Academy of Sciences*. (2014) 24;111(25):9289-94. PMID: 24927544
16. Fraser KB, **Moehle MS**, Daher JP, Webber PJ, Williams JY, et al. LRRK2 secretion in exosomes is regulated by 14-3-3. *Human Molecular Genetics*. (2013) 15;22(24):4988-5000. PMID: 23886663
17. **Moehle MS**, Luduena RF, Haroutunian V, Meador-Woodruff JH, McCullumsmith RE. Regional differences in expression of β-tubulin isoforms in schizophrenia. *Schizophrenia Research*. (2012) 135(1-3):181-6. PMID: 22264600
18. **Moehle MS**, Webber PJ, Tse T, Sukar N, Standaert DG, et al. LRRK2 inhibition attenuates microglial inflammatory responses. *Journal of Neuroscience*. (2012) 1;32(5):1602-11.PMID: 22302802

**References**

***Lori McMahon, Ph.D. – Professor and Dean (Graduate School Program Director).***

* *Dean, UAB Graduate School, Jarman F. Lowder Professor of Neuroscience, Director UAB Comprehensive Neuroscience Center, University of Alabama at Birmingham*
  + *mcmahon@uab.edu*
  + *205-996-2945*

***Andrew B. West, Ph.D. – Professor (Former Graduate School Advisor)***

* *Professor, Dept. of Pharmacology and Cancer Biology, Duke University*
  + *andrew.west@duke.edu*
  + *919-684-1656*

***Craig Lindsley, Ph.D. – Professor and Co-Director (K99 Advisory Committee Member)***

* *Director of Medicinal Chemistry, William K Warren Chair in Medicine, University Professor of Pharmacology, Biochemistry and Chemistry, Vanderbilt University*
  + *Craig.lindsley@vanderbilt.edu*
  + *615-322-8700*

***P. Jeffrey Conn, Ph.D. – Professor and Director (Current Post-Doc Advisor)***

* *Director of the Vanderbilt Center for Neuroscience Drug Discovery, Lee E. Limbird Professor of Pharmacology, Vanderbilt University*
  + *Jeff.conn@vanderbilt.edu*
  + 615-936-2189