

Mark Stephen Moehle, Ph.D.

Professional
Vanderbilt Center for Neuroscience Drug Discovery
1205 Light Hall
Nashville, TN 37232
mark.moehle@vanderbilt.edu

Personnel
4209 Park Ave
Nashville, TN 37209
225-715-9928
msmoehle@gmail.com

Education

<i>Centenary College of Louisiana – Shreveport, LA</i> B.S. Neuroscience – <i>cum laude</i>	2006-2010
<i>University of Alabama at Birmingham – Birmingham, AL</i> Ph.D. Neurobiology	2010-2015
<i>Vanderbilt University - Nashville, TN</i> Postdoctoral Fellow	2015-Present

Academic Appointments

Graduate Research Trainee University of Alabama at Birmingham	2010-2015
Postdoctoral Fellow Vanderbilt University, Dept. of Pharmacology, VCND	2015-Present

Professional Organizations

Society for Neuroscience	2007-Present
American Association for the Advancement of Science	2010-2015

Professional Activities

<i>Ad Hoc</i> Reviewer <i>Neuroscience</i> <i>Neuropsychopharmacology</i> <i>Molecular and Cellular Neuroscience</i> <i>Brain Research</i>	2016-Present
--	--------------

Journal Club Leader - Electrophysiology Journal Club	2015-Present
Middle Tennessee Chapter of SFN Travel Award	2017
Mahlon DeLong Young Investigator Award	2016-2017
UAB Graduate Biomedical Sciences Admissions Committee	2013-2014
UAB Neuroscience Admissions Committee	2011-2013
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

Teaching Activities

Mentor to:

<ul style="list-style-type: none"> • Christopher Price Withers <ul style="list-style-type: none"> ○ Currently Sophomore at Vanderbilt University 	2018-present
<ul style="list-style-type: none"> • Augusto Diedrich <ul style="list-style-type: none"> ○ Currently Sophomore at Vanderbilt University 	2018-present
<ul style="list-style-type: none"> • Randi Bruce <ul style="list-style-type: none"> ○ Currently a Law Student at Belmont University 	2016-2018
<ul style="list-style-type: none"> • Hemal Baghat <ul style="list-style-type: none"> ○ Currently a medical student at UAB 	2012-2014
<ul style="list-style-type: none"> • Shelia Bhavsar <ul style="list-style-type: none"> ○ Currently a medical student at Creighton University 	2011-2012
Teaching Assistant; Molecular Mechanisms of Memory, UAB	2011
Teaching Assistant; Dauphin Island Sea Lab Course, UAB	2011

Research Program

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

Publications and Presentations

Articles

Moehle, MS and Conn, PJ. Roles of the M₄ Acetylcholine Receptor in the Basal Ganglia and the Treatment of Movement Disorders. *Movement Disorders*. (2019) Accepted

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 M₄ muscarinic receptor allosteric modulators. *Molecular Psychiatry*. (2018) 10.1038/s41380-018-0206-2. PMID 30116027

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.

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

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;

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

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

Moehle MS, West AB. M1 and M2 immune activation in Parkinson's Disease: Foe and ally?. *Neuroscience*. (2015) 27;302:59-73. PMID: 25463515

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

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

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

Liu Z, Galembo 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

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

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

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

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

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;

Presentations and Invited Lectures

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. 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, Rook, JM, Foster, DJ, Yohn, SE, Niswender, CM, Jones, CK, Lindsley, CW, and Conn PJ. Selective antagonists of the M₄ muscarinic acetylcholine receptor relieve parkinsonian motor deficits. **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. 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 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).

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)