

## CURRICULUM VITAE

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#### EDUCATION/TRAINING:

1995-1999 Stanford University, Palo Alto, CA Postdoctoral Fellow in Neurophysiology  
1995 Yale University, New Haven, CT Ph.D. in Psychobiology  
1983: Fudan University, Shanghai, China B.S. in Neurobiology

#### PROFESSIONAL EXPERIENCES:

2006-present: Research Assistant Professor, Department of Pharmacology, Vanderbilt University Medical School, Nashville, TN.  
1999-2006: Research Assistant Professor, Neuroscience Institute, University of Tennessee, Health Science Center, Memphis, TN.  
1995-1999: Postdoctoral Research Fellow, Department of Neurology and Neurological Sciences, Stanford University Medical Center, Palo Alto, CA.

#### PROFESSIONAL MEMBERSHIP:

1995-present Society for Neuroscience

#### OTHER PROFESSIONAL SERVICE:

Reviewer for Journal articles:

*Progress in Neuro-Psychopharmacology & Biological Psychiatry*  
*Neuroscience*  
*Journal of Neurophysiology*  
*Neurobiology of Aging*  
*Life Science; Journal of Neuroscience*  
*ACS Chemical Neuroscience*  
*Neuron*  
*Journal of Clinical Neuroscience*  
*Cell Reports*  
*Journal of Neurochemistry*

Review Panel Member:

*NIH Neurological Science and Disorders C Study Section*

Member of Undergraduate Honors Thesis Committee: *Vanderbilt University*

Mentor for undergraduate student research in the Neuroscience research courses: *Vanderbilt University*

#### PEER-REVIEWED PUBLICATIONS:

1. **Xiang Z**, Lv X, Maksymetz J, Stansley BJ, Ghoshal A, Rocco G, Gogliotti RG, Niswender CM, Lindsley CW, Conn PJ (2019) mglu5 positive allosteric modulators facilitate long-term

- potentiation via disinhibition mediated by mglu5-endocannabinoid signaling. *ACS Pharmacology & Translational Science [Articles ASAP (As Soon As Publishable)]*
2. Moran SP, **Xiang Z**, Doyle CA, Maksymetz J, Lv X, Faltin S, Rook JM, Lindsley CW, Conn PJ (2019) Biased M1 positive allosteric modulators reveal critical role of phospholipase D in M1-dependent rodent cortical plasticity. *PNAS (submitted)*
  3. Moran SP, Dickerson JW, Cho HP, **Xiang Z**, Maksymetz J, Remke DH, Lv X, Doyle CA, Rajan DH, Niswender CM, Engers DW, Lindsley CW, Rook JM, Conn PJ (2018) M1-positive allosteric modulators lacking agonist activity provide the optimal profile for enhancing cognition. *Neuropsychopharmacology. 43(8):1763-1771. PMID:29581537*
  4. Moehle MS, Pancani T, Byun N, Yohn SE, Wilson GH 3rd, Dickerson JW, Remke DH, **Xiang Z**, Niswender CM, Wess J, Jones CK, Lindsley CW, Rook JM, Conn PJ (2017) Cholinergic Projections to the Substantia Nigra Pars Reticulata Inhibit Dopamine Modulation of Basal Ganglia through the M4 Muscarinic Receptor. *Neuron. 96(6):1358-1372. PMID: 29268098*
  5. Gogliotti RG, Senter RK, Fisher NM, Adams J, Zamorano R, Walker AG, Blobaum AL, Engers DW, Hopkins CR, Daniels JS, Jones CK, Lindsley CW, **Xiang Z**, Conn PJ, Niswender CM (2017) mGlu7 potentiation rescues cognitive, social, and respiratory phenotypes in a mouse model of Rett syndrome. *Sci Transl Med.16;9(403). PMID: 28814546*
  6. Ghoshal A, Moran SP, Dickerson JW, Joffe ME, Grueter BA, **Xiang Z**, Lindsley CW, Rook JM, Conn PJ (2017) Role of mGlu5 Receptors and Inhibitory Neurotransmission in M1 Dependent Muscarinic LTD in the Prefrontal Cortex: Implications in Schizophrenia. *ACS Chem Neurosci.8(10):2254-2265. PMID: 28679049*
  7. Walker AG, Sheffler DJ, Lewis AS, Dickerson JW, Foster DJ, Senter RK, Moehle MS, Lv X, Stansley BJ, **Xiang Z**, Rook JM, Emmitte KA, Lindsley CW, Conn PJ (2017) Co-Activation of Metabotropic Glutamate Receptor 3 and Beta-Adrenergic Receptors Modulates Cyclic-AMP and Long-Term Potentiation, and Disrupts Memory Reconsolidation. *Neuropsychopharmacology. 42(13):2553-2566. PMID: 28664928*
  8. Lv X, Dickerson JW, Rook JM, Lindsley CW, Conn PJ, **Xiang Z** (2017) M1 muscarinic activation induces long-lasting increase in intrinsic excitability of striatal projection neurons. *Neuropharmacology. 118:209-222. PMID28336323*
  9. Foster DJ, Wilson JM, Remke DH, Mahmood MS, Uddin MJ, Wess J, Patel S, Marnett LJ, Niswender CM, Jones CK, **Xiang Z**, Lindsley CW, Rook JM, Conn PJ (2016) Antipsychotic-like effects of M4 positive allosteric modulators are mediated by CB2 receptor-dependent inhibition of dopamine release. *Neuron 91(6):1244-52. PMC5033724*
  10. Senter RK, Ghoshal A, Walker AG, **Xiang Z**, Niswender CM, Conn PJ (2016). The role of mGlu receptors in hippocampal plasticity deficits in neurological and psychiatric disorders: Implications for allosteric modulators as novel therapeutic strategies. *Curr Neuropharmacol. 14(5):455-73. PMC4983746*
  11. **Xiang Z**, Conn PJ (2016). Novel PAMs targeting NMDAR GluN2A subunit. *Neuron. 89(5):884-6. PMC4793964*
  12. Pancani T, Foster DJ, Moehle MS, Bichell TJ, Bradley E, Bridges TM, Klar R, Poslusney M, Rook JM, Daniels JS, Niswender CM, Jones CK, Wood MR, Bowman AB, Lindsley CW, **Xiang Z\***, Conn PJ\* (2016). Allosteric activation of M4 muscarinic receptors improve behavioral and physiological alterations in early symptomatic YAC128 mice. Allosteric activation of M4 muscarinic receptors improve behavioral and physiological alterations in early symptomatic YAC128 mice. *Proc Natl Acad Sci USA, 112(45):14078-83. PMC4653197 (\*co-corresponding authors)*
  13. Ghoshal A, Rook JM, Dickerson JW, Roop GN, Morrison RD, Jalan-Sakrikar N, Lamsal A, Noetzel MJ, Poslusney MS, Wood MR, Melancon BJ, Stauffer SR, **Xiang Z**, Daniels JS, Niswender CM, Jones CK, Lindsley CW, Conn PJ (2015) Potentiation of M1 Muscarinic

- Receptor Reverses Plasticity Deficits and Negative and Cognitive Symptoms in a Schizophrenia Mouse Model. *Neuropsychopharmacology*. 41(2):598-610. PMID: 26108886
14. Nickols HH, Yuh JP, Gregory KJ, Morrison RD, Bates BS, Stauffer SR, Emmitte KA, Bubser M, Peng W, Nedelcovych MT, Thompson A, Lv X, **Xiang Z**, Daniels JS, Niswender CM, Lindsley CW, Jones CK, Conn PJ (2016). VU0477573: Partial Negative Allosteric Modulator of the Subtype 5 Metabotropic Glutamate Receptor with In Vivo Efficacy. *J Pharmacol Exp Ther*. 356(1):123-36. PMC4702078
  15. Garcia-Barrantes PM, Cho HP, Niswender CM, Byers FW, Locuson CW, Blobaum AL, **Xiang Z**, Rook JM, Conn PJ, Lindsley CW (2015) Development of novel, CNS penetrant positive allosteric modulators for the metabotropic glutamate receptor subtype 1 (mGlu1), based on an N-(3-Chloro-4-(1,3-dioxoisindolin-2-yl)phenyl)-3-methylfuran-2-carboxamide scaffold, that potentiate wild type and mutant mGlu1 receptors found in schizophrenics. *J Med Chem*. 58(20):7959-71. PMC4839290
  16. Gould RW, Dencker D, Grannan M, Bubser M, Zhan X, Wess J, **Xiang Z**, Locuson C, Lindsley CW, Conn PJ, Jones CK (2015) Role for the M1 Muscarinic Acetylcholine Receptor in Top-Down Cognitive Processing Using a Touchscreen Visual Discrimination Task in Mice. *ACS Chem Neurosci*. 6(10):1683-95. PMC483047
  17. Klar R, Walker AG, Ghose D, Grueter BA, Engers DW, Hopkins CR, Lindsley CW, **Xiang Z**, Conn PJ, Niswender CM (2015) Activation of Metabotropic Glutamate Receptor 7 Is Required for Induction of Long-Term Potentiation at SC-CA1 Synapses in the Hippocampus. *J Neurosci*. 35(19):7600-15. PMC4429158
  18. Rook JM\*, **Xiang Z\***, Lv X, Ghoshal A, Dickerson JW, Bridges TM, Johnson KA, Foster DJ, Gregory KJ, Vinson PN, Thompson AD, Byun N, Collier RL, Bubser M, Nedelcovych MT, Gould RW, Stauffer SR, Daniels JS, Niswender CM, Lavreysen H, Mackie C, Conde-Ceide S, Alcazar J, Bartolomé-Nebreda JM, Macdonald GJ, Talpos JC, Steckler T, Jones CK, Lindsley CW, Conn PJ (2015) Biased mGlu5-Positive Allosteric Modulators Provide In Vivo Efficacy without Potentiating mGlu5 Modulation of NMDAR Currents. *Neuron*. 20;86(4):1029-40. PMC4429158 (\*co-first authors)
  19. Jalan-Sakrikar N, Roper-Field J, Klar R, Mattman M, Walker AG, Zamorano R, **Xiang Z**, Byers CF, Blobaum AL, Engers D, Weaver CD, Days E, Utlej TJ, Melancon B, Daniels JS, Wood MR, Lindsley CW, Conn PJ, Hopkins CR, Niswender CM (2015) The discovery and characterization of a centrally penetrant (ML396) and a peripherally restricted (ML397) pan-Group III mGlu positive allosteric modulators. *Probe Reports from the NIH Molecular Libraries Program [Internet]*. Bethesda (MD): National Center for Biotechnology Information (US). PMID: 25834902
  20. Walker AG, Wenthur CJ, **Xiang Z**, Rook JM, Emmitte KA, Niswender CM, Lindsley CW, Conn PJ (2015) Metabotropic glutamate receptor 3 activation is required for long-term depression in medial prefrontal cortex and fear extinction. *Proc Natl Acad Sci USA*, 112(4):1196-201. PMC4313856
  21. Jalan-Sakrikar N, Field JR, Klar R, Mattmann ME, Gregory KJ, Zamorano R, Engers DW, Bollinger SR, Weaver CD, Days EL, Lewis LM, Utlej TJ, Hurtado M, Rigault D, Acher F, Walker AG, Melancon BJ, Wood MR, Lindsley CW, Conn PJ, **Xiang Z**, Hopkins CR, Niswender CM (2014) Identification of positive allosteric modulators VU0155094 (ML397) and VU0422288 (ML396) reveals new insights into the biology of metabotropic glutamate receptor 7. *ACS Chem Neurosci*. 5(12):1221-37. PMC4306484
  22. Pancani T, Bolarinwa C, Smith Y, Lindsley CW, Conn PJ, **Xiang Z** (2014) M4 mAChR-mediated modulation of glutamatergic transmission at corticostriatal synapses. *ACS Chem Neurosci*. 5(4):318-24. PMC3990947
  23. Foster DJ, Gentry PR, Lizardi-Ortiz JE, Bridges TM, Wood MR, Niswender CM, Sulzer D, Lindsley CW, **Xiang Z**, Conn PJ (2014) M5 Receptor Activation Produces Opposing Physiological Outcomes in Dopamine Neurons Depending on the Receptor's Location. *J Neurosci* 34(9):3253-62. PMC3935086

24. Turlington M, Noetzel MJ, Chun AC, Zhou Y, Gogliotti RD, Nguyen ED, Gregory KJ, Vinson PN, Rook JM, Gogi KK, **Xiang Z**, Bridges TM, Daniels JS, Jones CK, Niswender CM, Meiler J, Conn PJ, Lindsley CW, Stauffer SR (2013) Exploration of allosteric agonism structure-activity relationships within an acetylene series of metabotropic glutamate receptor 5 (mGlu5) positive allosteric modulators (PAMs): discovery of 5-((3-fluorophenyl)ethynyl)-N-(3-methyloxetan-3-yl)picolinamide (ML254). *J Med Chem.* 56(20):7976-96. [PMC3908770](#)
25. Bridges TM, Rook JM, Noetzel MJ, Morrison RD, Zhou Y, Gogliotti RD, Vinson PN, **Xiang Z**, Jones CK, Niswender CM, Lindsley CW, Stauffer SR, Conn PJ, Daniels JS (2013) Biotransformation of a novel positive allosteric modulator of metabotropic glutamate receptor subtype 5 contributes to seizure-like adverse events in rats involving a receptor agonism-dependent mechanism. *Drug Metab Dispos.* 41(9):1703-14. [PMC3876804](#)
26. Noetzel MJ, Gregory KJ, Vinson PN, Manka JT, Stauffer SR, Lindsley CW, Niswender CM, **Xiang Z**, Conn PJ. (2013) A novel metabotropic glutamate receptor 5 positive allosteric modulator acts at a unique site and confers stimulus bias to mGlu5 signaling. *Mol Pharmacol.* 83(4):835-47. [PMC3608436](#)
27. Rook JM, Noetzel MJ, Pouliot WA, Bridges TM, Vinson PN, Cho HP, Zhou Y, Gogliotti RD, Manka JT, Gregory KJ, Stauffer SR, Dudek FE, **Xiang Z**, Niswender CM, Daniels JS, Jones CK, Lindsley CW, Conn PJ. (2013) Unique signaling profiles of positive allosteric modulators of metabotropic glutamate receptor subtype 5 determine differences in *in vivo* activity. *Biol Psychiatry.* 73(6):501-9. [PMC3572342](#)
28. Digby GJ, Noetzel MJ, Bubser M, Utlej TJ, Walker AG, Byun NE, Lebois EP, **Xiang Z**, Sheffler DJ, Cho HP, Davis AA, Nemirovsky NE, Mennenga SE, Camp BW, Bimonte-Nelson HA, Bode J, Italiano K, Morrison R, Daniels JS, Niswender CM, Olive MF, Lindsley CW, Jones CK, Conn PJ (2012). Novel allosteric agonists of M1 muscarinic acetylcholine receptors induce brain region-specific responses that correspond with behavioral effects in animal models. *J Neurosci.* 32(25):8532-44. [PMC3398407](#)
29. Tarr JC, Turlington ML, Reid PR, Utlej TJ, Douglas J, Sheffler DJ, Cho HP, Klar R, Pancani T, Klein MT, Bridges TM, Morrison RD, Anna L. Blobaum, **Xiang Z**, Daniels JS, Niswender CM, Conn PJ, Wood MR, Lindsley CW (2012) Targeting selective activation of M1 for the treatment of Alzheimer's disease: further chemical optimization and pharmacological characterization of the M1 positive allosteric modulator ML169. *ACS Chemical Neuroscience.* 3(11):884-95. [PMC3503349](#)
30. **Xiang Z**, Thompson AD, Jones CK, Lindsley CW, Conn PJ (2012) Roles of M1 muscarinic acetylcholine receptor subtype in regulation of basal ganglia function and implication for treatment of Parkinson's disease. *J Pharmacol Exp Ther.* 340(3):595-603. [PMC3286317](#)
31. Noetzel MJ, Rook JM, Vinson PN, Cho HP, Days E, Zhou Y, Rodriguez AL, Lavreysen, Stauffer SR, Niswender CM, **Xiang Z**, Daniels JS, Lindsley CW, Weaver CD, Conn PJ (2012) Functional impact of allosteric agonist activity of selective positive allosteric modulators of metabotropic glutamate receptor subtype 5 in regulating central nervous system function. *Mol Pharmacol,* 81(2):120-33. [PMC3263948](#)
32. Johnson KA, Niswender CM, Conn PJ, **Xiang Z** (2011) Activation of group II metabotropic glutamate receptors induces long-term depression of excitatory synaptic transmission in the substantia nigra pars reticulata. *Neuroscience Letters* 504(2):102-6. [PMC3556513](#)
33. Lebois EP, Digby GJ, Sheffler DJ, Melancon BJ, Tarr JC, Cho HP, Miller NR, Morrison R, Bridges TM, **Xiang Z**, Scott Daniels J, Wood MR, Conn PJ, Lindsley CW (2011) Development of a highly selective, orally bioavailable and CNS penetrant M1 agonist derived from the MLPCN probe ML071. *Bioorg Med Chem Lett.* 21(21):6451-5. [PMC3190051](#)
34. **Xiang Z**, Thompson AD, Brogan JT, Schulte ML, Melancon BJ, Mi D, Lewis LM, Zou B, Yang L, Morrison R, Santomango T, Byers F, Brewer K, Aldrich JS, Yu H, Dawson ES, Li M, McManus O, Jones CK, Daniels JS, Hopkins CR, Xie XS, Conn PJ, Weaver CD, Lindsley CW (2011) The discovery and characterization of ML218: a novel, centrally active T-type

- calcium channel inhibitor with robust effects in STN neurons and in a rodent model of Parkinson's disease. *ACS Chemical Neuroscience* 2: 730–742. [PMC3285241](#)
35. Lebois EP, Bridges TM, Lewis LM, Dawson ES, Kane AS, **Xiang Z**, Jadhav SB, Yin H, Kennedy JP, Meiler J, Niswender CM, Jones CK, Conn PJ, Weaver CD, Lindsley CW (2010) Discovery and Characterization of Novel Subtype-Selective Allosteric Agonists for the Investigation of M1 Receptor Function in the Central Nervous System. *ACS Chemical Neuroscience* 1:104-121. [PMC3180826](#)
  36. Sheffler DJ, Williams R, Bridges TM, **Xiang Z**, Kane AS, Byun NE, Jadhav S, Mock MM, Zheng F, Lewis LM, Jones CK, Niswender CM, Weaver CD, Lindsley CW, Conn PJ (2009) A novel selective muscarinic acetylcholine receptor subtype 1 (M1 mAChR) antagonist reduces seizures without impairing hippocampal-dependent learning. *Mol Pharmacol.* 76(2):356-68. [PMC2713127](#)
  37. Shirey JK, Brady AE, Jones PJ, Davis AA, Bridges TM, Kennedy JP, Jadhav SB, Menon UN, **Xiang Z**, Watson ML, Christian EP, Doherty JJ, Quirk MC, Snyder DH, Lah JJ, Levey AI, Nicolle MM, Lindsley CW, Conn PJ (2009) A selective allosteric potentiator of the M1 muscarinic acetylcholine receptor increases activity of medial prefrontal cortical neurons and restores impairments in reversal learning. *J Neurosci.* 29(45):14271-86. [PMC2811323](#)
  38. Ayala JE, Chen Y, Banko JL, Sheffler DJ, Williams R, Telk AN, Watson NL, **Xiang Z**, Zhang Y, Jones PJ, Lindsley CW, Olive MF, Conn PJ. (2009) mGluR5 positive allosteric modulators facilitate both hippocampal LTP and LTD and enhance spatial learning. *Neuropsychopharmacology*, 34:2057-2071. [PMC2884290](#)
  39. Niswender CM, Johnson KA, Weaver CD, Jones CK, **Xiang Z**, Luo Q, Rodriguez AL, Marlo JE, de PT, Thompson AD, Days EL, Nalywajko T, Austin CA, Williams MB, Ayala JE, Williams R, Lindsley CW, Conn PJ (2008) Discovery, characterization, and antiparkinsonian effect of novel positive allosteric modulators of metabotropic glutamate receptor 4. *Mol Pharmacol.* 74(5):1345-58. [PMC2574552](#)
  40. Jones PJ, **Xiang Z** and Conn PJ (2008) Metabotropic glutamate receptors mGluR4 and mGluR8 regulate transmission in the lateral olfactory tract-piriform cortex synapse. *Neuropharmacology* 55:440-446. [PMC2644556](#)
  41. Jones CK, Brady AE, Davis AA, **Xiang Z**, Bubser M, Tantawy MN, Kane A, Bridges TM, Kennedy JP, Bradley SR, Peterson TE, Baldwin RM, Kessler R, Deutch AY, Levey AI, Lindsley CW and Conn PJ (2008) Novel Selective Allosteric Activator of the M1 Muscarinic Acetylcholine Receptor Reduces Amyloid Processing and Produces Antipsychotic-like Activity in Rats. *J Neurosci.* 28:10422-33. [PMC2577155](#)
  42. Shirey JK\*, **Xiang Z\***, Orton D, Brady AE, Myers-Johnson KA, Williams R, Ayala JE, Rodriguez AL, Wess, J, Weaver D, Niswender CM and Conn PJ (2008) Discovery of novel selective allosteric potentiators of the M<sub>4</sub> mAChR suggests a role in modulating excitatory but not inhibitory synaptic transmission in the hippocampus. *Nature Chem Biol*, 4(1):42-50. [PMID:18059262](#) (**\*co-first authors**)
  43. Benneyworth MA\*, **Xiang Z\***, Smith RL, Garcia EE, Conn PJ and Sanders-Bush E (2007) A Selective Positive Allosteric modulator of metabotropic glutamate receptor subtype 2 blocks a hallucinogenic drug model of psychosis. *Mol Pharmacol* 72(2):477-84. [PMID:17526600](#) (**\*co-first authors**)
  44. Wang L, Kitai ST. and **Xiang Z** (2006) Activity-dependent bidirectional modification of inhibitory synaptic transmission in rat subthalamic neurons. *J Neurosci.* 26(28):7321-7. [PMID:16837578](#)
  45. Wang L, and Kitai ST and **Xiang Z** (2005) Modulation of excitatory synaptic transmission by endogenous glutamate acting on presynaptic group II mGluRs in rat substantia nigra compacta. *J. Neurosci. Res.* 93(3):1145-57. [PMID:16273546](#)
  46. **Xiang Z**, Wang L and Kitai ST (2005) Modulation of spontaneous firing in rat subthalamic neurons by 5-HT receptor subtypes. *J. Neurophysiology*, 93: 1145–1157. [PMID: 15738272](#)

47. Duntsch CD, Zhou Q, Jayakar HR, Weimar JD, Robertson JH, Pfeffer LM, Wang L, **Xiang Z**, and Whitt MA (2004) Recombinant vesicular stomatitis virus vectors as oncolytic agents in the treatment of high-grade gliomas in an organotypic brain tissue slice-glioma coculture model. *J. Neurosurgery*, 100(6):1049-59. PMID: 15200120
48. **Xiang Z**. and Prince DA (2003) Heterogeneous actions of serotonin on interneuronal functions in rat visual cortex. *J. Neurophysiol.* 89, 1278-1287. PMID:12626611
49. **Xiang Z**, Huguenard JR and Prince DA (2002) Synaptic inhibition of pyramidal cells evoked by different interneuronal subtypes in layer V of rat visual cortex. *J. Neurophysiol.*, 88, 740-750. PMID: 12163526
50. **Xiang Z**, Huguenard JR and Prince DA (1998) Cholinergic switching within neocortical inhibitory networks. *Science* 281, 985-988. PMID: 9703513
51. **Xiang Z**, Huguenard, JR and Prince DA (1998) GABA<sub>A</sub> receptor-mediated currents in interneurons and pyramidal cells of rat visual cortical. *J. Physiol.*, 506, 715-730. PMC2230760
52. **Xiang Z** and Brown TH (1998) Complex synaptic current waveforms evoked in hippocampal pyramidal neurons by extracellular stimulation of dentate gyrus. *J. Neurophysiol.*, 79(5):2475-2484. PMID: 9582221
53. **Xiang Z**, Greenwood AC, Kairiss EW and Brown TH (1994). Quantal mechanism of long-term potentiation in mossy-fiber synapses. *J. Neurophysiol.*, 71, 2552-2556. PMID: 7931534
54. Claiborne BJ, **Xiang Z** and Brown TH (1993). Hippocampal circuitry complicates analysis of long-term potentiation in mossy-fiber synapses. *Hippocampus*, 3, 115-122. PMID: 8353597
55. Weisz DJ, Harden DG and **Xiang Z** (1992). Effects of amygdala lesions on reflex facilitation and conditioned response acquisition during nictitating membrane response conditioning in rabbit. *Behavioral Neurosci.* 106, 262-273. PMID: 1317182
56. Yang B-Y and **Xiang Z** (1988). The modulatory role of hippocampus in learned response of cerebellum during the nictitating membrane conditioning of the rabbit. *Chinese J. Physiol. Sci.* 4(2), 99-107.

## MEETING PRESENTATIONS

- Manuel TJ, Kusunose J, **Xiang Z**, Caskey CF (2019) Optical observation of calcium signaling in response to FUS neuromodulation. *NIH BRAIN initiative meeting, 2019*
- Moran SP, Doyle CA, Cho HP, **Xiang Z**, Maksymetz JT, Faltin S, Niswender CM, Rook JM, Lindsley CW, Conn PJ (2019) Biased M1 positive allosteric modulators reveal critical role of phospholipase D in M1 PAM enhancement of cortical function. *45th Annual Meeting of Society for Neuroscience*
- Lavery ML, Foster DJ, None. S.E. Yohn SE, Moehle MS, Dickerson JW, Covey DP, Peng W, **Xiang Z**, Rook JM, Cheer JF, Conn PJ (2017) M4 receptor activation normalizes dopaminergic signaling in Huntington's Disease mouse models. *44th Annual Meeting of Society for Neuroscience*
- Moran SP, Doyle CA, **Xiang Z**, Plumley HC, Dickerson JW, Remke DH, Niswender CM, Engers DW, Lindsley CW, Rook JM, Conn PJ (2017) M1 Allosteric modulators without agonist activity in the medial prefrontal cortex may provide the optimal profile for cognition enhancement. *44th Annual Meeting of Society for Neuroscience*
- Moehle MS, T. Pancani T, Yohn S, Byun N, Dickerson J, Remke D, Jones C, **Xiang Z**, Niswender C, Wess J, Wilson G, Lindsley C, Rook J, Conn J (2017) Hindbrain cholinergic projections to the substantia nigra pars reticulata regulate direct pathway dopamine signaling. *44th Annual Meeting of Society for Neuroscience*

- Niswender CM, Gogliotti RG, Fisher NM, Senter R, Gould RW, Adams JJ, Stansley BJ, Walker AG, Zamorano R, Blobaum AL, Engers DW, Hopkins CR, Lindsley CW, Jones CK, **Xiang Z**, Conn PJ (2016) Metabotropic glutamate receptor 7 as a therapeutic target in MECP2-related disorders. *43th Annual Meeting of Society for Neuroscience*
- Moehle MS, Pancani T, Byun N, **Xiang Z**, Wess J, Rook JM, Niswender CM, Jones CK, Lindsley CW, Conn PJ (2016). D1 receptor activation in the SNr evokes GABA release and increased motor activity and is tonically inhibited by M4 receptor signaling *43th Annual Meeting of Society for Neuroscience*.
- Foster DJ, Wilson J, Pancani T, Wess J, Jones CK, **Xiang Z**, Conn PJ (2015) M4-muscarinic receptors attenuate striatal dopamine release via production of a local messenger in direct pathway medium spiny neurons. *42th Annual Meeting of Society for Neuroscience*.
- Ghoshal A, Moran SP, Rook JM, Dickerson JW, **Xiang Z**, Lindsley CW, Conn PJ (2015) Role of GABAA receptors and mGlu5 signaling in M1-dependent long-term depression in prefrontal cortex. *42th Annual Meeting of Society for Neuroscience*.
- Klar R, Gogliotti RG, Walker AG, Zamorano R, Engers DW, Ghose D, Grueter BA, Hopkins CR, Lindsley CW, **Xiang Z**, Conn PJ, Niswender CM (2015) mGlu7 is critical for hippocampal plasticity and is a potential therapeutic target for the treatment of Rett Syndrome. *42th Annual Meeting of Society for Neuroscience*
- Maksymetz JT, Ghoshal A, Lv X, Rook JM, Lindsley CW, **Xiang Z**, Conn PJ (2015) Stimulus bias by mGlu5 positive allosteric modulators affects long term potentiation in the hippocampus through involvement of endocannabinoids and GABAergic disinhibition. *42th Annual Meeting of Society for Neuroscience*
- Pancani T, Bichell TJ, Foster D, Bradley E, Ferguson MC, Bridges TM, Daniels JS, Bowman AB, Lindsley CW, Conn PJ, **Xiang Z** (2014) Age dependent changes in M4-mediated control of striatal glutamate and dopamine signaling in the YAC128 mouse model of Huntington's disease. *41th Annual Meeting of Society for Neuroscience*.
- Foster D, **Xiang Z**, Conn PJ (2014) M4-muscarinic receptors attenuate dopamine release via production of H<sub>2</sub>O<sub>2</sub> in direct pathway medium spiny neurons. *41th Annual Meeting of Society for Neuroscience*.
- Ghoshal A, Rook JM, Dickerson JW, Morrison RD, Stauffer SR, Jones CK, Daniels JS, Niswender CM, Lindsley CW, **Xiang Z**, Conn, PJ (2014) Evaluation of the therapeutic efficacy of M1 muscarinic acetylcholine receptor potentiation in chronic phencyclidine-treated mouse model of schizophrenia. *41th Annual Meeting of Society for Neuroscience*.
- Walker AG, Wenthur CJ, **Xiang Z**, Lindsley CW, Conn PJ (2014) Activation of metabotropic glutamate receptor 3 (mGlu3) is required for the induction of long-term depression in medial prefrontal cortex and fear extinction learning. *41th Annual Meeting of Society for Neuroscience*.
- Panarese DJ, Rook JM, Poslusney MS, Melancon BJ, Bridges TM, Cho HP, Dickerson J, Hopkins CR, Wood MR, **Xiang Z**, Morrison R, Stauffer SR, Daniels JS, Niswender C, Jones CK, Conn PJ, Lindsley CW (2014) Development of non-isatin M1 positive allosteric modulators. *American Chemical Society Division of Medicinal Chemistry 248th ACS National Meeting MEDI 130*.
- Pancani T, Bowman AB, Bichell TJ, Bridges TM, Daniels JS, Lindsley CW, Jones C, Conn PJ, **Xiang Z** (2013) Characterization of Novel M4 PAM in Huntington's disease mouse model. *40th Annual Meeting of Society for Neuroscience*.
- Lv X, Lindsley CW, Conn PJ, **Xiang Z** (2013) Selective activation of cholinergic interneurons induces long-lasting enhancement of intrinsic excitability of striatal medium spiny neurons. *40th Annual Meeting of Society for Neuroscience*.

- Foster DJ, Gentry PR, **Xiang Z**, Lindsley CW, Conn, PJ (2013) M5-muscarinic receptors engender different physiological outcomes in SNc neurons depending on their subcellular location. *40th Annual Meeting of Society for Neuroscience*.
- Ghoshal A, Rook JM, Johnson KA, Lv X, Dickerson JW, Lambert Collier R L, Vinson PN, Stauffer SR, Jones CK, Niswender CM, Lindsley CW, **Xiang Z**, Conn, PJ (2013) Stimulus bias of metabotropic glutamate receptor 5 allosteric modulators - impact on CNS effects and implications for use as therapeutic agents. *40th Annual Meeting of Society for Neuroscience*.
- Walker AG, Wenthur CJ, **Xiang Z**, Morrison RD, Byers FW, Daniels JS, Lindsley CW, Conn, PJ (2013) Novel negative allosteric modulators reveal a role of metabotropic glutamate receptor 3 (mGlu3) in long-term depression in medial prefrontal cortex: Implications for cognition. *40th Annual Meeting of Society for Neuroscience*.
- Gould RW, Nedelcovych MT, Dencker D, Grannan MD, Bubster M, Stauffer SR, Wood SR, Lindsley CR, **Xiang Z**, Wess J, Conn PJ, Jones, CK (2013) Evaluation of M1 muscarinic acetylcholine receptor influence on sleep/wake architecture and cognition in rodents. *Experimental Biology 2013*.
- Pancani T, Lindsley CW, Conn PJ, **Xiang Z** (2012) M4 muscarinic receptor-mediated modulation of glutamatergic signaling in the striatum. *39th Annual Meeting of Society for Neuroscience*.
- Foster DJ, Gentry PR, Bridges TM, **Xiang Z**, Lindsley CW, Conn, PJ (2012) Examination of M5-muscarinic receptor neurophysiology in substantia nigra pars compacta neurons using the allosteric modulator VU0238429. *39th Annual Meeting of Society for Neuroscience*.
- Walker AG, Sheffler DJ, **Xiang Z**, Conn, PJ (2012) Regulation of synaptic transmission and plasticity by astrocytic mGlu3 at the Schaffer collateral - CA1 synapse. *39th Annual Meeting of Society for Neuroscience*.
- Noetzel, MJ, Gregory KJ, Vinson PN, Manka J., Stauffer SR, Xiang Z, Daniels JS, Niswender CM, Lindsley CW, Conn PJ. (2012) Characterization of a potent and efficacious metabotropic glutamate receptor 5 positive allosteric modulator from the CPPHA series, *39th Annual Meeting of Society for Neuroscience*.
- Pancani T, Jones CK, Conn PJ, Lindsley C, **Xiang Z** (2012) Effects of M4 muscarinic receptor modulation on glutamatergic signaling in striatum: Implications for Parkinson's Disease. *14th Annual Udall Center Directors' Meeting*.
- Field JR, Melancon BJ, Zamorano MR, Engers DW, Salovich JM, Cheung YY, Days EL, Lewis LM, Z. **Xiang Z**, Weaver CD, Jones CK, Wood MR, Hopkins CR, Lindsley CW, Conn PJ, Niswender CM (2012) *Keystone Symposia on Molecular and Cellular Biology: GPCR-Molecular Mechanism and Novel Function Insights*
- Xiang Z**, Thompson, A.D., Jones, C.K., Lindsley CW, Conn PJ (2011) Roles of M1 mAChR subtype in regulation of basal ganglia function and implication for treatment of Parkinson's disease. *XIX World Congress on Parkinson's Disease and Related Disorders*.
- Digby, GJ, Utley TJ, Adam WG, Sheffler DJ, Herman, EJ, **Xiang Z**, Plumbley, HC, Davis AA, N. E. Byun NE, Colleenn NM, Carrie, JK, Lindsley CW, Conn, PJ (2011). Characterization of M1-selective partial agonists VU0364572 and VU0357017: Evidence for brain region-specific electrophysiological and behavioral effects. *38th Annual Meeting of Society for Neuroscience*.
- Foster DJ, Bridges TM, **Xiang Z**, Conn PJ (2011) Elucidation of M5-muscarinic receptor neurophysiology in midbrain dopamine neurons using the novel allosteric modulator VU0238429. *38th Annual Meeting of Society for Neuroscience*.
- Noetzel, MJ, Gregory KJ, Rook JM, Vinson PN, Cho HP, Stauffer SR, Xiang Z, Daniels JS, Niswender CM, Lindsley CW, Conn PJ. (2011) Characterization of novel metabotropic glutamate receptor 5 positive allosteric modulators utilizing in vitro and in vivo studies. *7th International Meeting on Metabotropic Glutamate Receptors*.
- Johnson KA, Sheffler DJ, Niswender CM, **Xiang Z**, Conn PJ (2010) Group II metabotropic glutamate receptor activation induces long-term depression of excitatory transmission in the substantia nigra pars reticulata. *37th Annual Meeting of Society for Neuroscience*.



- Digby, GJ, Hanson, BJ, **Xiang Z**, Lebois, EP, Lindsley CW, Conn, PJ (2010). Allosteric-induced agonist-directed trafficking at M<sub>1</sub> muscarinic acetylcholine receptors. *37th Annual Meeting of Society for Neuroscience*.
- Sheffler DJ, Williams R, Bridges TM, **Xiang Z**, Kane AS, Byun NE, Jadhav S, Mock MM, Zheng F, Lewis LM, Jones CK, Niswender CM, Weaver CD, Lindsley CW, Conn PJ (2009) A novel selective muscarinic acetylcholine receptor subtype 1 (M1 mAChR) antagonist reduces seizures without impairing hippocampal-dependent learning. *36th Annual Meeting of Society for Neuroscience*.
- Shirey JK, **Xiang Z**, Orton D, Brady AE, Myers-Johnson KA, Williams R, Ayala JE, Rodriguez AL, Wess, J, Weaver D, Niswender CM and Conn PJ. (2008) An allosteric potentiator suggests a role for M4 muscarinic acetylcholine receptor (mAChR) in modulating hippocampal synaptic transmission. *Experimental Biology 2008*.
- Jones PJ, **Xiang Z** and Conn P (2007) The role of group III L-AP4-sensitive metabotropic glutamate receptors in the lateral olfactory tract piriform cortex synapse. *34th Annual Meeting of Society for Neuroscience*.
- Ayala J, Chen J, Rodriguez A, **Xiang Z** and Conn PJ (2007) A positive allosteric modulator of mGluR5 reduces the amplitude of synaptic NMDA receptor currents at the Schaffer collateral-CA1 synapse of the rat hippocampus. *33rd Annual Meeting of Society for Neuroscience*
- Wang L and **Xiang Z** (2005) Activity-dependent modification of GABAergic synaptic transmission in rat subthalamic nucleus. *31st Annual Meeting of Society for Neuroscience*.
- Wang L and **Xiang Z** (2004) Long-lasting enhancement of GABAergic inhibitory synaptic transmission in subthalamic neurons by serotonin. *30th Annual Meeting of Society for Neuroscience*.
- Wang L, Kitai ST, Kita H and **Xiang Z** (2003) Modulation of neuronal activity and synaptic transmission in subthalamic neurons by serotonin. *29th Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Wang L, Teng B and Kitai ST (2002) Group II metabotropic glutamate receptor-mediated tonic inhibition of excitatory synaptic transmission in substantia nigra pars compacta dopamine neurons. *28th Annual Meeting of Society for Neuroscience*.
- Wang L, **Xiang Z**, Teng B, Atherton JF, Johnson E and Kitai ST (2002) Blockade of Dopaminergic receptors induces burst discharges in subthalamic neurons in organotypic co-cultures. *28th Annual Meeting of Society for Neuroscience*.
- Xue Y, Teng B, Wang X, **Xiang Z** and Kitai ST (2002) Immunohistochemical localization of Group II metabotropic glutamate receptor associated with rat substantia nigra pars compacta dopamine neurons: a light and ultrastructural study. *28th Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Wang L, Teng B and Kitai ST (2001) Bursting activity of substantia nigra par reticulata neurons by synaptic inputs from and subthalamic and tegumental pedunclopontine nucleus in rat organotypic culture. *27th Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Rohrbacher J, Teng B and Kitai ST (2000) Modulation of firing patterns of nigra doparmine neurons by tegumental pedunclopontine nucleus and subthalamic nucleus in rat organotypic culture. *26th Annual Meeting of Society for Neuroscience*.
- Fujiyama F, Teng B, **Xiang Z** and Kitai ST (2000) Ultrastructures studies of subthalamus and substantial nigra neurons and subthalamic projection to nigral dopamine cells in rat organotypic culture preparation. *26th Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Huguenard JR and Prince DA (1999) Serotonergic modulation of interneuronal functions in rat visual cortex. *25th Annual Meeting of Society for Neuroscience*.
- Xiang Z** Huguenard JR and Prince DA (1998) Cholinergic modulation of inhibitory network in rat visual cortex. *24th Annual Meeting of Society for Neuroscience*.

- Xiang Z**, Huguenard JR and Prince DA (1997) Differential cholinergic modulation of interneuronal excitability in layer V interneurons of rat visual cortex. *51st Annual Meeting of The American Epilepsy Society*.
- Xiang Z**, Parada I, Huguenard JR and Prince DA (1997) Unitary inhibitory currents in layer V pyramidal cells of rat visual cortex. *23rd Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Huguenard JR and Prince DA (1996) Comparison of GABA<sub>A</sub> receptor-mediated synaptic currents in rat visual cortical layer V interneurons and pyramidal cells. *22nd Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Greenwood AC and Brown TH (1994). Quantal basis of facilitation and LTP in rat hippocampal mossy fiber synapses. *21st Annual Meeting of Society for Neuroscience*.
- Greenwood, AC., **Xiang, Z.** and Brown, TH (1993). Likelihood surfaces illuminate uncertainty in quantal analysis. *20th Annual Meeting of Society for Neuroscience*.
- Greenwood, A. C., **Xiang, Z.**, Landaw, E. M., Kairiss, E. W. and Brown, T. H. (1992). Quantal analysis of plasticity in rat hippocampal mossy fiber synapses. *19th Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Greenwood AC and Brown TH (1992). Measurement and analysis of hippocampal mossy fiber synaptic currents. *18th Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Nobre AC and Brown TH (1991). Isolated mossy fiber synaptic currents in CA3 pyramidal neurons. *18th Annual Meeting of Society for Neuroscience*.
- Xiang Z**, Kairiss EW, Keenan CL, Landaw EM and Brown TH (1990). Quantal model of synaptic current fluctuation in hippocampal neurons. *17th Annual Meeting of Society for Neuroscience*.
- Nobre AC **Xiang Z**, Zador AM and Brown TH (1990). Voltage-dependence of the NMDA receptor-mediated synaptic conductance in hippocampus. *16th Annual Meeting of Society for Neuroscience*.
- Kairiss EW, Chapman PF, Keenan CL, **Xiang Z** and Brown TH (1989). Confocal scanning laser microscopy of intracellularly injected amygdala neurons. *15th Annual Meeting of Society for Neuroscience*.

## RESEARCH SUPPORT:

### Research Grants (current)

**R01 MH111877** PI: Caskey 09/23/2016 – 06/30/2020  
 NIH/MH Establishing a dose response for ultrasound neuromodulation  
 Role: Co-Investigator/Lead PI for VU subcontract

### Research Grants (completed)

**National TSA Research Grant** PI: Xiang 06/14/2013 – 02/08/2016  
 TSA M4 PAMs as Potential Therapeutic Agents in Treatment of Tourette Syndrome  
 Role: PI

**R01 NS065867** PI: Xiang 04/01/2010 – 03/31/2016  
 NIH/NINDS M1 and M4 mAChRs in striatum-implication in treatment of movement disorders  
 Role: PI

**Cure Dystonia Initiative Grant** PI: Xiang 04/15/2007 – 04/14/2009  
 DMRF Modulation of subthalamic function by mAChRs: Implication in treatment of dystonia  
 Role:PI