

**Seungwoo Kang, Ph.D.**

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**EDUCATION**


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Ph.D. in Pharmacology and Toxicology, University of California, Irvine, Irvine, CA	2014
M.S. in Neurobiology, Korea University, Seoul, South Korea	2008
B.S. in Life Sciences, Korea University, Seoul, South Korea	2005

**RESEARCH POSITIONS AND EXPERIENCE**


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<b>Assistant Professor (Research Scientist), Mayo Clinic</b> , Rochester, MN Dept. of Molecular Pharmacology and Experimental Therapeutics	2020-present
<b>Assistant Professor (Research Associate), Mayo Clinic</b> , Rochester, MN Dept. of Molecular Pharmacology and Experimental Therapeutics	2018-2020
<b>Research Associate, Mayo Clinic</b> , Rochester, MN Dept. of Molecular Pharmacology and Experimental Therapeutics	2017-2018
<ul style="list-style-type: none"> <li>• Advisor: Doo-Sup Choi, Ph.D.</li> <li>• Demonstrated the astrocyte-neuron interaction via gliotransmitters in the striato-pallidal circuit for reward-seeking patterns and addictive behaviors</li> <li>• Set new experimental techniques at CHOI Lab including <i>in vivo</i> calcium imaging with fiber-photometry/microendoscopy and <i>in vivo/ex vivo</i> electrophysiology combining optogenetics, computational analysis to measure behavior-synchronized brain activities</li> </ul>	
<b>Postdoctoral Fellow, Rutgers University</b> , New Jersey Medical School, Newark, NJ Dept. of Anesthesiology, Pharmacology, Physiology, and Neuroscience	2014-2017
<ul style="list-style-type: none"> <li>• Advisor: Jiang-Hong Ye, M.D., M.Sc.</li> <li>• Demonstrated the role of lateral habenula circuit in alcoholism and comorbid disorders including anxiety, depression, and hyperalgesia</li> <li>• Set chemogenetics at Ye Lab to manipulate spatiotemporal brain activities</li> </ul>	
<b>Graduate Student, University of California, Irvine</b> , Irvine, CA Dept. of Pharmacology, School of Medicine	2010-2014
<ul style="list-style-type: none"> <li>• Advisor: Naoto Hoshi, M.D., Ph.D.</li> <li>• Demonstrated the cellular and molecular signal cascade of M-type potassium channel and its role in neuronal excitability modulation</li> </ul>	
<b>Graduate Student/Research Associate, Korea University</b> , Seoul, South Korea Neurobiology Program, Dept. of Pharmacology, College of Medicine	2005-2010
<ul style="list-style-type: none"> <li>• Advisor: Kyung-Ho Shin, M.D.</li> <li>• Involved in pharmacogenomic studies for psychotropic drug and demonstrated the effects of antidepressants in neurons of rodent stress models</li> </ul>	

## RESEARCH SUPPORT

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### Current

**K01 AA027773** Role: **PI** 09/15/19 – 08/31/23  
(NIH/NIAAAA, PI: Kang, S)

#### **Astrocytic Dysfunction in Anxiety and Depression during Alcohol Withdrawal**

This grant investigates the tripartite synaptic mechanisms and molecules related to alcohol use disorder (AUD) using a combination of electrophysiological, pharmacological, optical, behavioral, transgenic, and computational approaches.

**R01 AG072898** Role: **Co-I** 09/30/20 – 05/31/25  
(NIH/NIA, PI: Choi, DS/Trushina, E)

#### **Chronic Alcohol Exposure and Pathophysiology of Alzheimer's Disease**

This grant investigates whether alcohol exposure has sex and/or age-dependent effect exacerbating the onset and development of Alzheimer's Disease (AD) using two mouse models representing familial and late-onset sporadic AD.

## AWARDS AND HONORS

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- Selected for the NIH Brain Initiative Summer Course on Interdisciplinary Computational Neuroscience at University of Missouri-Columbia 2019
- Neuroscience 2018 Travel Award - Japan Neuroscience Society (JNS) 2018
- RSA Junior Investigator Travel Award - Research Society on Alcoholism (RSA) 2016, 2017
- SfN Trainee Professional Development Award - Society for Neuroscience (SfN) 2016
- RBHS OVCR Research Travel Award - Rutgers Biomedical and Health Sciences 2016
- Awarded Brain Korea 21 (BK21) Scholarship by Korea University (supported by The National Research Foundation of Korea) 2005-2007

## PUBLICATIONS

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### Primary Research Articles

1. Khazal FA, **Kang S**, Holte M, Choi DS, Singh R, Saenz P, Lopez-Barneo J, Maher J. Unexpected obesity, rather than tumorigenesis, in a conditional mouse model of mitochondrial complex II deficiency. (2020) *FASEB Journal*. Nov 27. doi: 10.1096/fj.202002100R. [PMID: 33247500](#)
2. **Kang S**<sup>#</sup>, Hong SI<sup>#</sup>, Lee JY, Lee H, Peyton L, Baker M, Choi S, Kim H, Chang SY, Choi DS. Activation of astrocytes in the dorsomedial striatum facilitates transition from habitual to goal-directed reward-seeking behavior. (2020) *Biological Psychiatry*. November 15; 88:797-808. <sup>#</sup>equally contributed to this work. [PMID: 32564901](#)
3. Nahar L, Grant CA, Hewett C, Cortes D, Reker AN, **Kang S**, Choi DS, Nam HW. Regulation of Pv-Specific Interneurons in the Medial Prefrontal Cortex and Reward-Seeking Behaviors. (2020) *Journal of Neurochemistry*. Jun 27. doi: 10.1111/jnc.15106. [PMID: 32594517](#)
4. Hong SI<sup>#</sup>, **Kang S**<sup>#</sup>, Chen J, Choi DS. Indirect medium spiny neurons in the dorsomedial striatum regulate ethanol containing conditioned reward seeking. (2019) *Journal of Neuroscience*. 39(36) 7206-7217. <sup>#</sup>equally contributed to this work. [PMID: 31315945](#)

5. **Kang S**, Li J, Zuo W, Chen P, Gregor D, Fu R, Han X, Bekker A, Ye JH. Downregulation of M-channels in lateral habenula mediates hyperalgesia during alcohol withdrawal in rats. (2019) *Scientific Reports*. 9(1):2714. [PMID: 30804373](#)
6. Starski P, Hong SI, Peyton L, Oliveros A, Winger K, Hutchison C, **Kang S**, Karpyak V, Choi DS. Ethanol induces maladaptive impulse control and decreases seeking behaviors in mice. (2019) *Addiction Biology*. Apr 22:e12754. [PMID: 31012186](#)
7. **Kang S**, Li J, Bekker A, Ye JH. Rescue of glutamate transport in the lateral habenula alleviates depression- and anxiety-like behaviors in ethanol withdrawn rats. (2018) *Neuropharmacology*. 129:47-56. [PMID: 29128307](#)
8. Li J<sup>#</sup>, **Kang S**<sup>#</sup>, Fu R, Wu L, Wu W, Liu H, Gregor D, Zuo W, Ye JH. Inhibition of AMPA receptor and CaMKII activity in the lateral habenula reduces depression-like behaviors and alcohol intake in rats. (2017) *Neuropharmacology*. 126:108-120. <sup>#</sup>equally contributed to this work. [PMID: 28865912](#)
9. Greene D, **Kang S**, Hoshi N. XE991 and Linopirdine are state-dependent inhibitors for Kv7/KCNQ channels that favor activated single subunits. (2017) *Journal of Pharmacology and Experimental Therapeutics*. 362:177-185. [PMID: 28483800](#)
10. **Kang S**, Li J, Fu R, Zuo W, Gregor D, Krnjevic K, Bekker A, Ye JH. Ethanol withdrawal drives anxiety-related behaviors by reducing M-type potassium channel activity in the lateral habenula. (2017) *Neuropsychopharmacology*. 42(9):1813-1824. [PMID: 28387223](#)
11. Li J, Fu C, Liu H, Fu R, Zuo W, **Kang S**, Chen P, Gregor D, Paulose R, Bekker A, Ye HJ. Electroacupuncture attenuates hyperalgesia in rats withdrawn from chronic ethanol drinking involving habenular mu opioid receptors. (2017) *Alcoholism: Clinical and Experimental Research*. 41(3):637-643. [PMID: 28166603](#)
12. Zuo W, Wang L, Chen L, Krnjevic K, Fu R, Feng X, He W, **Kang S**, Shah A, Bekker A, Ye JH. Ethanol potentiates both GABAergic and glutamatergic signaling in the lateral habenula. (2016) *Neuropharmacology*. 113:178-187. [PMID: 27678415](#)
13. Fu R, Chen X, Zuo W, Li J, **Kang S**, Zhou LH, Siegel A, Bekker A, Ye JH. Ablation of  $\mu$  opioid receptor-expressing GABA neurons in rostromedial tegmental nucleus increases ethanol consumption and regulates ethanol-related behaviors. (2016) *Neuropharmacology*. 107:58-67. [PMID: 26921770](#)
14. Kay HY, Greene D, **Kang S**, Kosenko A, Hoshi N. M-current preservation contributes to anticonvulsant effects of valproic acid. (2015) *Journal of Clinical Investigation*. 125:3904-3914. [PMID: 26348896](#)
15. Kim H, **Kang S**, Kim HJ, Choi SH, Shin S, Lee HH, Rhim H, Shin KH. Effect of acute and chronic electroconvulsive shock on 5-hydroxytryptamine 6 receptor immunoreactivity in rat hippocampus. (2014) *Experimental Neurobiology*. 23(3):231-7. [PMID: 25258570](#)
16. **Kang S**, Xu M, Cooper EC, Hoshi N. Channel-anchored protein kinase CK2 and protein phosphatase 1 reciprocally regulate KCNQ2-containing M-channels via phosphorylation of calmodulin. (2014) *Journal of Biological Chemistry*. 289(16):11536-44. [PMID: 24627475](#)
17. Kosenko A, **Kang S**, Smith IM, Greene DL, Langeberg LK, Scott JD, Hoshi N. Coordinated signal integration at the M-type potassium channel upon muscarinic stimulation. (2012) *The EMBO Journal*. 31(14):3147-56. [PMID: 22643219](#)
18. Greene D, **Kang S**, Kosenko A, Hoshi N. Adrenergic regulation of HCN4 channel requires protein association with  $\beta$ 2-adrenergic receptor. (2012) *Journal of Biological Chemistry*. 287(28):23690-7. [PMID: 22613709](#)

19. **Kang S**, Kim HJ, Kim HJ, Shin SK, Choi SH, Lee MS, Shin KH. Effects of reboxetine and citalopram pretreatment on changes in cocaine and amphetamine regulated transcript (CART) expression in rat brain induced by the forced swimming test. (2010) *European Journal of Pharmacology*. 647(1-3):110-6. [PMID: 20826136](#)
20. Moon BH, **Kang S**, Kim HJ, Shin SK, Choi SH, Lee MS, Kim MK, Shin KH. Effect of reboxetine pretreatment on the FST-induced gene expression profile in the rat lateral septum. (2008) *Molecular & Cellular Toxicology*. 4(1):31-44. [KOREASCIENCE](#)
21. Moon BH, Hong CG, Kim SY, Kim HJ, Shin SK, **Kang S**, Lee KJ, Kim YK, Lee MS, Shin KH. A single administration of 2,3,7,8-tetrachlorodibenzo-p-dioxin that produces reduced food and water intake induces long-lasting expression of corticotropin-releasing factor, arginine vasopressin, and proopiomelanocortin in rat brain. (2008) *Toxicology and Applied Pharmacology*. 233(2):314-22. [PMID: 18824019](#)
22. Park SH, Seo YH, Moon BH, Choi SH, **Kang S**, Lee KJ, Choi SH, Lee MS, Chun BG, Shin KH. Lamotrigine prevents MK801-induced alterations in early growth response factor-1 mRNA levels and immunoreactivity in the rat brain. (2008) *European Journal of Pharmacology*. 589(1-3):58-65. [PMID: 18550051](#)
23. Park SH, Choi SH, Lee J, **Kang S**, Shin YC, Kim HJ, Kim HJ, Shin SK, Lee MS, Shin KH. Effects of repeated citalopram treatments on chronic mild stress-induced growth associated protein-43 mRNA expression in rat hippocampus. (2008) *Korean Journal of Physiology and Pharmacology*. 12(3):117-23. [PMID: 20157404](#)
24. Kim SJ, Park SH, Choi SH, Moon BH, Lee KJ, **Kang S**, Lee MS, Choi SH, Chun BG, Shin KH. Effects of repeated tianeptine treatment on CRF mRNA expression in non-stressed and chronic mild stress-exposed rats. (2006) *Neuropharmacology*. 50(7):824-33. [PMID: 16504218](#)

#### **Reviews, Book Chapters, and Commentaries**

25. **Kang S**, Choi DS. Astrocyte adenosine signaling and neural mechanisms of goal and habitual reward seeking behaviors. (2021) *Neuropsychopharmacology*. 46(1):227–228. [PMID: 32778692](#)
26. Baker M, Hong SI, **Kang S**, Choi DS. Rodent Models for Psychiatric Disorders: Problems and Promises. (2020) *Laboratory Animal Research*. Apr 15;36:9. [PMID: 32322555](#)
27. **Kang S**, Choi D-S. Possible Benefit and Validity of Supplements for Alcohol Use Disorder. (2019) *Alcoholism: Clinical and Experimental Research*. May;43(5):780-782. [PMID: 30802317](#)
28. Wininger K, Karpyak V, **Kang S**, Choi DS. "Central role of amygdala and hypothalamus neural circuits in alcohol withdrawal symptom". *Neuroscience of Alcohol*. Elsevier (Editor Victor Preedy). Chapter 26, pp 249-256, 2019. [ELSEVIER](#)
29. Lindberg D, Andres-Beck L, Jia YF, **Kang S**, and Choi DS. Purinergic Signaling in Neuron-Astrocyte interactions, Circadian Rhythms and Alcohol Use Disorder. (2018) *Frontiers in Physiology*. 9:9. [PMID: 29467662](#)
30. Shah A, Zuo W, **Kang S**, Li J, Fu R, Zhang H, Bekker A, Ye JH. The lateral habenula and alcohol: Role of glutamate and M-type potassium channels. (2017) *Pharmacology Biochemistry and Behavior*. 162:94-102. [PMID: 28624587](#)
31. **Kang S**. The Role of Casein Kinase 2 in Ion Channel Remodeling After Myocardial Infarction: Editorial to: "Valsartan Upregulates Kir2.1 in Rats Suffering from Myocardial Infarction via Casein Kinase 2" by Xinran Li et al. (2015) *Cardiovascular Drugs and Therapy*. 29(3):207-8. [PMID: 26206620](#)

**My Bibliography in NCBI:** <https://www.ncbi.nlm.nih.gov/myncbi/1hy4a586mF0kQ/bibliography/public/>

## **TEACHING AND MENTORING EXPERIENCE**

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### **Class**

- *Neurobehavioral Pharmacology* (MPET 6815), Fall Quarter 2020 2020  
Lecturer, Mayo Clinic Graduate School of Biomedical Sciences
- *Introduction to Molecular Pharmacology* (MPET 5808), Fall Quarter 2019 2019  
Neuropsychiatric - Drugs of addiction I (alcohol & opiates)  
Lecturer, Mayo Clinic Graduate School of Biomedical Sciences

### **Student Mentorship**

- *Swikriti Shrestha*, Rotation Graduate Student in Pharmacology Ph.D. Program, Mayo Clinic Graduate School of Biomedical Sciences (GSBS) 2019
- *Matthew Baker*, Rotation Graduate Student in Pharmacology Ph.D. Program, Mayo Clinic GSBS 2019
- *Wei (Adelyn) Tsai*, Summer Undergraduate Research Fellows Program, Mayo Clinic GSBS, (University of Minnesota) 2019
- *Phillip Starski*, Graduate student in Neuroscience Ph.D. Program, Mayo Clinic GSBS 2018-2019
- *Lauren Rivera Pagan*, UPR-Mayo Summer Research Program, Mayo Clinic GSBS, (Medical Student in University of Puerto Rico) 2018
- *Pei Chen*, Exchange Graduate Student, Rutgers Biomedical and Health Sciences, (Beijing University of Chinese Medicine and Pharmacology) 2016-2017
- *Avi Shah*, Summer High School Student, Rutgers Biomedical and Health Sciences 2016
- *Liangzhi Wu*, Visiting Scholar, Rutgers Biomedical and Health Sciences, (The Second People's Hospital of Guangdong Province, China) 2015-2016
- *Hongwei Liu*, Exchange Graduate Student, Rutgers Biomedical and Health Sciences, (Beijing University of Chinese Medicine and Pharmacology) 2015-2016

## **SERVICE AND OUTREACH**

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### **Ad Hoc Reviewer**

Frontiers in Pharmacology, Plos One, Alcoholism: Clinical and Experimental Research, Neuroscience Letters, Cells, Biomolecules, International Journal of Molecular Sciences, Cardiovascular Drugs and Therapy Since 2015

### **Guest Editor**

Special Issue: The Neurobiological Mechanisms Underlying Individual Differences in Addiction, Journal of Personalized Medicine (ISSN: 2075-4426) 2020

### **Judge, GSBS Research Symposium Poster**

Rutgers University Graduate School of Biomedical Science, Research Symposium 2016

## **PROFESSIONAL MEMBERSHIPS**

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- Member, American Society for Pharmacology and Experimental Therapeutics 2019-present
- Overseas Member, The Japan Neuroscience Society 2018-present
- Member, Research Society on Alcoholism 2015-present
- Member, The New York Academy of Sciences 2014-present
- Member, The Society of Neuroscience 2007-present

## **PRESENTATIONS**

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### **Invited Talks**

- *University of South Florida, Taneja College of Pharmacy, Department of Pharmaceutical Sciences. "Astrocyte-Neuron Communication in Reward-Seeking and Alcohol Use Disorder"* 2020
- *Medical College of Georgia at Augusta University, Department of Pharmacology and Toxicology "Astrocyte-Neuron Communication in Reward-Seeking and Alcohol Use Disorder"* 2020
- *University of Texas at Tyler, Fisch College of Pharmacy, Department of Pharmaceutical Sciences "Pharmacotherapy in Alcohol Use Disorder"* 2020
- *University of Cincinnati, College of Medicine, Department of Pharmacology and Systems Physiology "The Role of Astrocyte-Neuron Communication in Alcohol Addiction"* 2020
- *Korea University, College of Life Science & Biotechnology, Division of Life Sciences "The Role of Lateral Habenular in Alcohol Use Disorder"* 2018

### **Conferences**

1. **Kang S, Choi DS.** Ethanol withdrawal differentially induces the spatiotemporal neuron and astrocyte activities in the dorsal striatum associated with social and anxiety-like behaviors. The 59<sup>th</sup> annual meeting of the American college of neuropsychopharmacology. Dec 6-9, 2020.
2. **Kang S, Choi DS.** Repeated ethanol exposures alter the reward-dependent striatopallidal neuronal activities in the dorsomedial striatum. The 59<sup>th</sup> annual meeting of the American college of neuropsychopharmacology. Dec 6-9, 2020.
3. **Kang S, Hong SI, Lee H, Choi DS.** The interaction of astrocytes and medium spiny neurons in dorsomedial striatum regulates adenosine-dependent reward-seeking behaviors. The 49<sup>th</sup> Society for Neuroscience annual meeting in Chicago, IL. Oct 19-23, 2019.
4. **Kang S, Hong SI, Paek B.S., Starski P, Peyton L, Choi DS.** Ent1-dependent adenosine signaling in the dorsomedial striatum regulates ethanol-containing reward seeking behaviors. The 42<sup>nd</sup> annual research society on alcoholism scientific meeting in Minneapolis, MN. June 22-26, 2019.
5. **Kang S, Li J, Bekker A, Choi DS, Ye JH.** Dysfunction of astrocytes in lateral habenula contributes to anxiety- and depressive-like behaviors during ethanol withdrawal. The 41<sup>th</sup> annual meeting of the Japan neuroscience meeting in Kobe, Japan. July 26-29, 2018.
6. **Kang S, Li J, Zuo W, Fu R, Gregor D, Ye JH.** Hyperactivity of lateral habenula neurons during alcohol withdrawal promotes anxiety-like behaviors involving downregulation of M-type K<sup>+</sup> channels. The 40<sup>th</sup> annual research society on alcoholism scientific meeting in Denver, CO. June 24-28, 2017.

7. **Kang S**, Li J, Ye JH. Ethanol withdrawal drives hyperalgesia via reduction of m-type potassium channels in the lateral habenula. The 46<sup>th</sup> Society for Neuroscience annual meeting in San Diego, CA. Nov 12-16, 2016.
8. **Kang S**, Ye JH. Glial dysfunction in lateral habenula contributes to anxiety- and depressive-like behaviors during ethanol withdrawal. The 39<sup>th</sup> annual research society on alcoholism scientific meeting in New Orleans, LA. June 25-29, 2016.
9. **Kang S**, Li J, Fu R, Zou W, Gregor D, Ye JH. M-channels in lateral habenula modulate anxiety behaviors and ethanol consumption in rats withdrawn from repeated ethanol exposure. The First annual Rutgers Brain Health Institute Symposium. Duncan Family Sky room at St. Peter's University, Jersey City. Oct 26, 2015.
10. **Kang S**, Ye JH. Increased excitability of lateral habenula neurons via down regulation of m-type potassium channel in rats withdrawn from repeated ethanol exposure. The 45th Society for Neuroscience annual meeting in Chicago, IL. Oct 17-21, 2015.
11. **Kang S**, Kosenko D, Greene N, Hoshi N. The regulation of M channel via phosphorylation of calmodulin by CK2. Program No. 246.08. The 42th Society for Neuroscience annual meeting in New Orleans, LA. Oct 13-17, 2012.
12. **Kang S**, Kim HJ, Kim S, Shin S, Shin KH. Effects of reboxetine and citalopram pretreatment on changes in cocaine and amphetamine regulated transcript (CART) expression in rat brain induced by the forced swimming test. Program No. 56.19. The 38th Society for Neuroscience annual meeting in Washington, D.C. Nov 12-16, 2008.
13. **Kang S**, Park SH, Lee KH, Lee MS, Shin KH. Effects of reboxetine and citalopram pretreatments on the forced swimming test-induced changes of early growth response-1 expression in rat brain. Program No. 711.2. The 37th Society for Neuroscience annual meeting in San Diego, CA. Nov 3-7, 2007.
14. **Kang S**, Park SH, Lee KJ, Lee MS, Shin KH. Effects of reboxetine and citalopram pretreatments on the forced swimming test-induced changes of early growth response-1 mRNA expression in rat brain. 2007F-159 (P-F4). The Korean Society for Brain and Neural Science annual meeting, Jeju, South Korea. Nov 16-17, 2007.