NEGIN MOHAMMADMIRZAEI

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Research Interests

The prevalence of opioid addiction in individuals with post-traumatic stress disorder (PTSD) is high. Individuals with PTSD are often prescribed opioidergic drugs for symptom relief. However, the long-term use of these drugs can cause addiction. My research interest concerns identifying the effect of PTSD on the brain on cellular, molecular, and a systems level using animal models and the appropriate technology, that will help discover new treatments which can address opioid substance abuse within PTSD.

Academic Performance

Ph.D.: Behavioral Neuroscience
University of Delaware - Newark, DE
- Finished first, second and third years with 4.00/4.00 GPA

Master of Science: Animal Physiology 2014
University of Tehran - Tehran, Iran
- Graduated with 3.93/4.00 GPA
- Finished as the Top student of the class 2014

Bachelor of Science: Animal Biology 2012
University of Tehran - Tehran, Iran
- Graduated with 3.64/4.00 GPA
- Finished as the second student of the class 2012

Publications

1. **Mohammadmirzaei, N.,** Biddle, M., Hekmatyar, K., Cai, X., Kulkarni, P., & Knox, D. (2021). The effect of traumatic stress on the mu-opioid receptors and connectivity within reward circuits. *Biological Psychiatry*, 89(9), S197.
2. Kimmelmann-Shultz, B., Farkash, A., Collins, B., **Mohammadmirzaei, N.**, and Knox, D. (2021) Using near-infrared fluorescence and high-resolution scanning to measure fear learning-induced changes in AMPA/NMDA ratios. *Learning and Memory*: (revised and resubmitted).
3. Knox, D., Della Valle, R., **Mohammadmirzaei, N.**, Shultz, B., Biddle, M., Farkash, A., ... & Moulton, E. (2020). PI3K-Akt signaling in the basolateral amygdala facilitates traumatic stress enhancements in fear memory. *International Journal of Neuropsychopharmacology*.
4. Della Valle, R., **Mohammadmirzaei, N.,** and Knox, D. (2019). The role of sensory cortex, thalamic nuclei, and the periaqueductal gray in mediating changes in emotional memory in the single prolonged stress model of post traumatic stress disorder. *Learning and Memory*, 26 (10): 403-411
5. Kimmelmann-Shultz, B., **Mohmammadmirzaei, N.**, Caplan, J., Knox, D. (2019). Using near-infrared fluorescence and high-resolution scanning to measure protein expression in the rodent brain. *JoVE (Journal of Visualized Experiments)*, (147), e59685.
6. **Mohammadmirzaei, N.**, Rezayof, A., and Ghasemzadeh, Z. (2016). Activation of cannabinoid CB1 receptors in the ventral hippocampus improved stress-induced amnesia in rat. *Brain research*, 1646: 219-226.

Presentations

1. Mohammadmirzaei, N., Biddle, M., Hekmatyar, K., Cai, X., Kulkarni, P., Knox, D. 2021, The effect of traumatic stress on the mu-opioid receptors and connectivity within reward circuits., Society of Biological Psychiatry. Virtual conference
2. Mohammadmirzaei, N., Biddle, M., Hekmatyar, K., Cai, X., Kulkarni, P., Knox, D. 2021, The effect of traumatic stress on the mu-opioid receptors, volume, and connectivity within reward circuits., University of Delaware 10th Annual Grad Students' Forum. Virtual conference
3. Mohammadmirzaei, N., Knox, D., 2019, The effect of traumatic stress on mu opioid receptor dynamics in brain regions associated with emotional learning and addiction., The Annual Delaware Neuroscience Research and Poster Symposium. Newark DE
4. Mohammadmirzaei, N., Knox, D., 2019, The effect of traumatic stress on mu opioid receptor dynamics in brain regions associated with emotional learning and addiction., Society for Neuroscience. Chicago IL
5. Shultz, B., Farkash, A., Collins, B., Mohammadmirzaei, N., Knox, D., 2019, Using high resolution near infrared imaging to measure fear-learning induced changes in AMPA/NMDA ratios throughout the fear circuit., Society for Neuroscience. Chicago IL
6. Mohammadmirzaei, N., Alicea Pauneto, A., Knox, D., 2019, The effect of traumatic stress on mu opioid receptor dynamics in brain regions associated with emotional learning and addiction., Pavlovian society, Vancouver, BC Canada
7. Mohammadmirzaei, N., Della Valle, R., Knox, D., 2018, Effects of traumatic stress on fear and extinction memory in the conditioned suppression paradigm., The Annual Delaware Neuroscience Research and Poster Symposium. Newark DE
8. Della Valle, R., Mohammadmirzaei, N., Moulton, E., Chamness, M., and Knox, D., 2018, The role of amygdala PI3K-Akt signaling in facilitating persistent fear in an animal model of PTSD., Society for Neuroscience. San Diego CA
9. Mohammadmirzaei, N., Della Valle, R., Knox, D., 2018, Effects of traumatic stress on fear and extinction memory in the conditioned suppression paradigm., Pavlovian society, IOWA IA
10. Mohammadmirzaei, N., Della Valle, R., Knox, D., 2017, Traumatic stress alters neural activity during fear and extinction learning and memory in non-sensory thalamic nuclei., The Annual Delaware Neuroscience Research and Poster Symposium. Newark DE
11. Mohammadmirzaei, N., Della Valle, R., Knox, D., 2017, Traumatic stress alters neural activity during fear and extinction learning and memory in non-sensory thalamic nuclei., Pavlovian society, Philadelphia PA
12. Mohammadmirzaei, N., Ghasemzadeh, Z., Rezayof, A., 2014, Blockade of ventral hippocampal cannabinoid CB1 receptors potentiated the stress-induced amnesia in rats., Basic and Clinical Neuroscience 3rd congress, Tehran, Iran
13. Mohammadmirzaei, N. Rezayof, A., 2014, Activation of ventral hippocampal CB1 cannabinoid receptors inhibited stress-induced amnesia in rats., 18th National and 6th International Congress of Biology, Kharazmi University, Karaj, Iran

Awards

1. **Doctoral Fellowship Award** 2020-2021
   Graduate College, University of Delaware, Newark, DE
2. **Poster Award** 2021
   10th Annual Graduate Students' Forum, University of Delaware, Newark, DE

Current Research Projects

1. **Title: Studying the effect of single prolonged stress (SPS) on biological parameters of reward circuit function which includes using small animal fMRI scanner**
   - **Description:** The onset of post-traumatic stress disorder (PTSD) often precedes and increases the risk for subsequent development of substance use disorder. Individuals with opioid dependence have the

highest prevalence of PTSD (33%) compared with all other substance abuse. In this project we use in vivo magnetic resonance imaging (MRI) to examine traumatic stress-induced changes in brain volume and functional connectivity patterns that could predispose individuals to opioid substance abuse.

2. **Title: Studying the effect of SPS on mu opioid receptor dynamics in reward and fear circuits**
    - **Description:** Hyperarousal and heightened anxiety are common symptoms of PTSD which are frequently addressed through opioidergic drug prescriptions. Opioidergic systems are also implicated in facilitating emotional reactivity, including the modulation of fear, the suppression of affective defense behavior, and anxiolysis. Since, endogenous opioids have inhibitory and modulatory roles in emotional responses, we hypothesized that Mu opioid receptor dysregulation in brain regions associated with emotional learning and memory may be particularly sensitive to the effects of traumatic stress. In order to test this hypothesis, we use the single prolonged stress (SPS) model of PTSD in rats. Mu opioid receptor levels are assessed and compared between SPS and control animals using different molecular approaches (i.e. immunohistochemistry and western blot).
3. **Title: Studying the effect of SPS on fear conditioned suppression**
    - **Description:** SPS is a frequently used model that mimics behavioral and psychological characteristics of PTSD such as persistent fear and anxiety. Previous studies have shown that SPS enhances conditioned freezing during fear extinction testing. We hypothesized that this enhancement is due to an enhancement of fear memory. To test this hypothesis, we developed a model of fear memory to examine how other forms of fear behaviors (other than the freezing behavior) are affected by SPS. Three fear behaviors were measured in this experiment; 1) freezing, 2) conditioned suppression, and 3) avoidance of the spatial location of the CS. We showed that behavioral paradigms that employ multiple measures of fear can provide more insight into how traumatic stress impacts emotional memory.
4. **Title: Using chemogenetic technology to explore the role of basal forebrain cholinergic neurons in fear conditioned suppression**
    - **Description:** Basal forebrain (BF) cholinergic neurons that project to the neocortex are critical for fear memory in the conditioned suppression paradigm. However, studies that have shown this have used techniques that permanently disrupted BF Cholinergic neurons, because it was not previously possible to selectively inhibit BF cholinergic neurons. Using ChAT;;cre rats we inserted the inhibitory DREADD hM4Di into BF cholinergic neurons and inhibited them during fear learning. We then examined how this treatment affected fear memory expression one day later. We observed that inhibiting BF cholinergic neurons during fear learning disrupted fear memory one day later.

Skills

- Running behavioral experiments- Inhibitory avoidance learning, Reward related learning, Fear conditioning and Fear extinction
- Using animal models of acute stress and post-traumatic stress disorder (e.g. single prolonged stress)
- Working with MedPC and Anymaze Behavioral tracking softwares
- Conducting imuunohistochemical assays-near infrared immunocytochemistry using Li-cor scanner
- Conducting double-labeling immunofluorescence assays
- Conducting western blot analysis
- Track tracing using CTB
- Performing cholinergic lesions using Saporin RIP
- Using Confocal fluorescence microscopy
- Working with SPSS and Graphpad statistical softwares
- Performing stereotaxic surgery for placement of cannulas and infusions
- Performing perfusion procedure
- Performing infusion procedure
- Conducting small animals' structural and fMRI

Teaching

Teaching Assistant for Brain and Behavior-PSYC314 08/2019 to 12/2019
University Of Delaware – Newark, DE

- Supported classroom activities, including tutoring, grading homework and reviewing exams
- Supported instructor with test administration, curriculum development and assignment grading

Teaching Assistant for Research Method-PSYC207 08/2018 to 12/2018
University of Delaware – Newark, DE

- Supported classroom activities, including tutoring, grading homework and reviewing exams
- Assessed student assignments to check quality and completeness and assign grades
- Supported instructor with test administration, curriculum development and assignment grading

Teaching Assistant for Brain and Behavior-PSYC314 02/2018 to 05/2018
University of Delaware – Newark, DE

- Supported classroom activities, including tutoring, grading homework and reviewing exams
- Supported instructor with test administration, curriculum development and assignment grading

Teaching Assistant for General Psychology-PSYC100 08/2017 to 12/2017
University of Delaware – Newark, DE

- Supported classroom activities, including tutoring, grading homework and reviewing exams
- Assessed student assignments to check quality and completeness and assign grades
- Supported instructor with test administration, curriculum development and assignment grading

Lab Teaching Assistant 07/2014 to 07/2015
University of Tehran – Tehran, Iran

- Worked with new students to understand requirements and provided training for performing experiments