BIOLOGICAL BASIS OF BEHAVIOR PROGRAM

# 26th Annual

# Student Research Symposium

## Celebrating 42 years
## 1978-2020

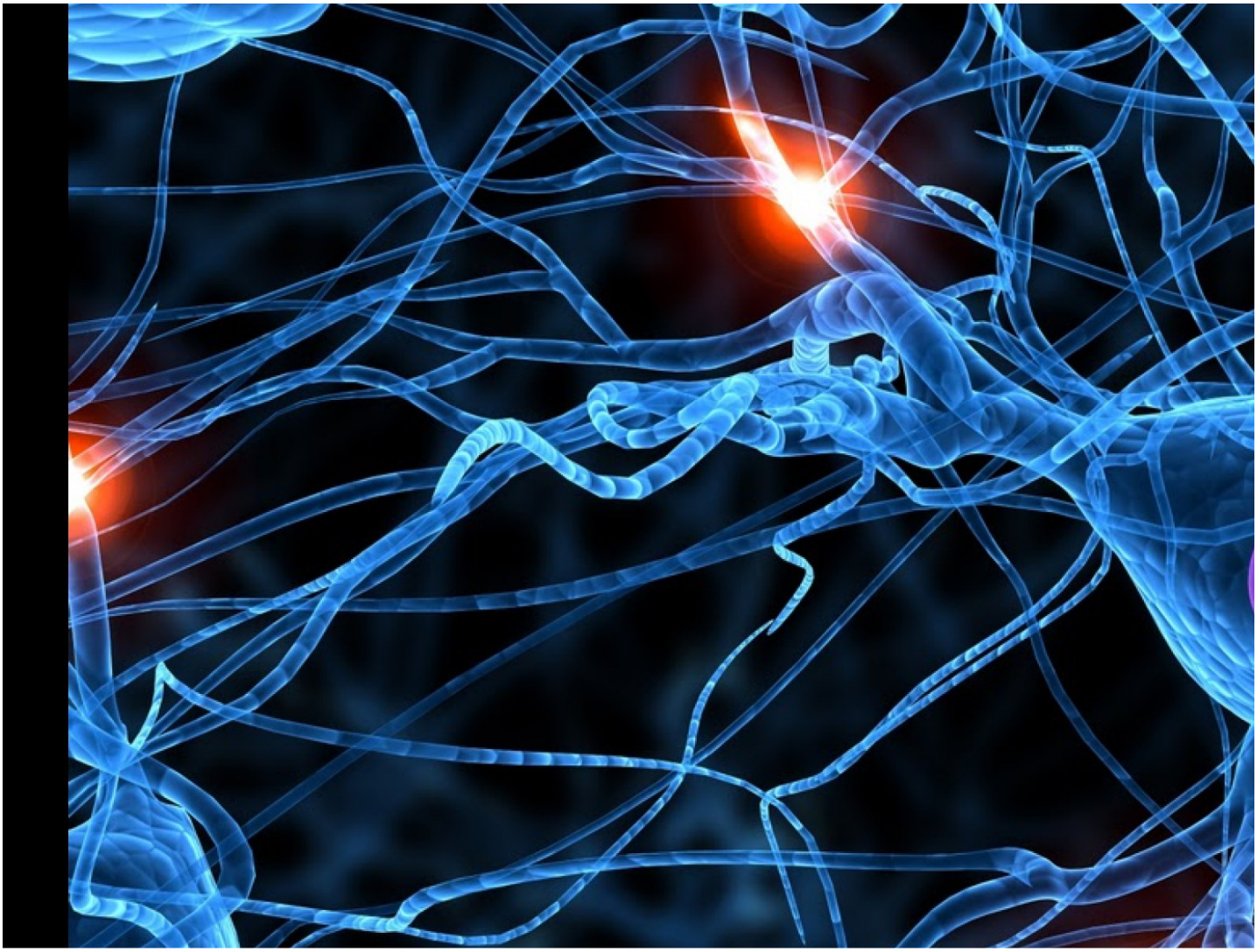
Friday, April 17, 2020

UNIVERSITY OF PENNSYLVANIA

## W e l c o m e

On behalf of the Biological Basis of Behavior Program. We welcome you to this very special day, our 26th Annual Student Virtual Research Symposium. It has been the goal of the program since its inception 42 years ago, to provide our BBB majors with the opportunity to work with faculty committed to multi-disciplinary teaching and research. Such a commitment is clearly evident in the research accomplishments of our majors showcased today. Whether you spend the entire day with us or just a portion of it, we are sure you will be impressed.

Dr. Lori Flannagan-Cato, Co-Director
Dr. Marc Schmidt, Co-Director



# Zoom Instructions for BBB Annual Symposium 2020

There are two zoom rooms for the live presentations. Room 1 and Room 2
Check the schedule to see your assigned room and presentation time.
Everyone should join the zoom room 15 minutes before the talks start to make sure everything is working.
Everyone will remain in the zoom room for their entire assigned session
Feel free to notify your PIs, lab members, family and friends with the zoom link

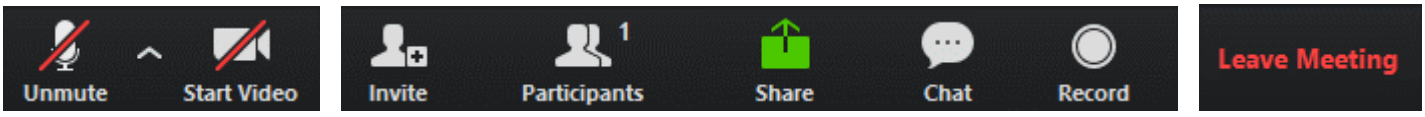
Here are the links for zoom rooms:

Room 1 (9 am – 2 pm)
https://sasupenn.zoom.us/j/91466275527

Room 2 (12 noon – 3 pm)
https://sasupenn.zoom.us/j/91168731922

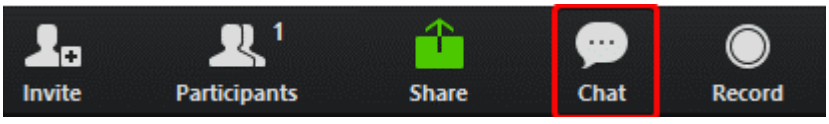
Prepare your PC to be viewed publicly. Close out of any unnecessary applications. If you are sharing your screen all participants will be able to see everything that you can.
Open up any material (Powerpoints, Videos) that you want to share. Navigate to Canvas, go to Announcements and click on the link for the date and room (Room 1 or Room 2) that the symposium is scheduled in.
Click 'Joinwith Computer Audio' if using a PC connected headset or dial in on a phone using the Meeting ID and Participant ID

When you log in to Zoom the microphone and camera will be turned off by default. Click Unmute to turn on the Microphone and Start Video to turn on your camera




When it is your turn to speak you can hit share to let everyone see your screen:

## Chat




All participants will have the ability to Chat with each other one-on-one or address everyone at once. This is a useful tool for troubleshooting participants issues if their audio isn't working.

# Biological Basis of Behavior
# Student Research Symposium
# Friday April 17, 2020

**BBB Research Symposium Room Assignments for Evaluators**

**Group 1**

Lori Flanagan-Cato
Jennifer Heerding
Mike Kaplan

**Group 2**

Marc Schmidt
Judith McLean
Mike Kane

9:00 **Session 1 (call into zoom rooms to set up)**

**Group 1**
**Zoom Room 1**
**Session 1**
9:15 Hareena Sangha
9:30 Angela Malinovitch
9:45 William Li
10:00 Samantha Steeman
10:15 Anita Kalluri

**Group2**

**CANVAS RECORDINGS**
9:15 Lydia Maliackel
9:30 Patrick Markwalter
9:45 Alexa Pisciotti
10:00 Luis Carvao
10:15 Donnisa Edmonds

**BREAK**

**Session 2**
10:30 Free
10:45 Free
11:00 Free

**CANVAS RECORDINGS**
10:30 Christopher Murraca
10:45 Saarang Karandikar
11:00 Dominique Martinez
11:15 Mikaela Glass

**Hareena Sangha**
Title: Prognostic Value of Cell-Free DNA in Patients with Glioblastoma
Supervisor: Dr. Erica Carpenter, MBA, PhD
Prognostic Value of Cell-Free DNA in Patients with Glioblastoma
Glioblastoma is the most common malignant brain tumor in adults, but prognostication of individual patients during is difficult as imaging has poor specificity and is slow to demonstrate tumor progression. We've shown that baseline cell-free DNA (cfDNA) concentration is prognostic; in other cancers this has been demonstrated at baseline and over time. Here, we utilize a larger cohort to assess the prognostic utility of cfDNA concentration in glioblastoma over time. First, we confirmed that high baseline cfDNA concentration is associated with poorer overall survival ($p=0.0025$) and progression-free survival ($p=0.0002$). Combining these data with MGMT promoter methylation, a prognostic biomarker in glioblastoma, provided further survival information. Though cfDNA concentration longitudinally didn't correlate with progression, it did predict death within 6 months. The time-point with the highest c-statistic (0.988, $p<0.0001$) was first MRI after radiation. This demonstrates potential utility of cfDNA concentration as a prognostic bio marker both at baseline and during therapy.

**Angela Malinovitch**
Title: In vitro characterization of EGFR-targeting CAR-T cells for Glioblastoma
Supervisor: Dr. Donald O'Rourke
Glioblastoma (GBM) is a the most common primary malignant brain tumor with an average survival time of only 12 -18 months. With limited treatment options, recent advances in CAR (Chimeric Antigen Receptor) T-cell therapy have led researchers to attempt to develop CAR constructs targeting GBM mutations, most notably EGFRvIII. However, EGFRvIII is only one of many co-occurring GBM mutations observed in patients, showing the eminent need for a cross reactive CAR, targeting multiple GBM mutations. In order to develop a new CAR construct targeting GBM mutations, we used molecular methods to insert a new scFv sequence, DSCAR, into a lentiviral transfer vector. We then used transfection to harvest lentivirus, followed by transduction of T cells. We then analyzed CAR expression on the T cells using FLOW cytometry and tested the in vitro killing ability of the newly generated CAR T cells against GBM mutant cell lines in vitro. Early results show promising expression and killing ability of DSCAR, but there is still work to be done before an effective treatment of GBM is ready for in human trials.

**William Li**
Title: Establishing a Flow Cytometry-Based Investigation of B Cell-Derived Extracellular Vesicles
Supervisor: Dr. Amit Bar-Or
Products carried by extracellular vesicles (EVs) derived from meningeal B cell aggregates have been implicated in the progression of subpial cortical lesions characteristic of progressive multiple sclerosis (MS). The present study aims to use a novel flow cytometry approach to identify human B cell-derived EVs, with the eventual goal of characterizing their differences in MS patients versus healthy controls. Antibodies against pan-B cell markers CD19, CD20, and CD22 in different fluorochromes were selected for initial staining of EVs in fresh and frozen platelet-poor plasma (PPP). When applied together in a pan-B cell panel, ideal antibody concentrations for co-staining EVs were 1.25µL APC anti-CD19, 10µL PE anti-CD20, and 5-10µL FITC anti-CD22 per 50µL sample. After different sample conditions and cytometer settings were tested, detection of B cell-derived EVs appeared to be most optimal by collecting CD19+/CD20+ double-positive events in fresh PPP with a low side scatter (SSC) threshold and SSC voltage set to 323V. These initial findings on one non-MS plasma sample show promise in this flow cytometry method to be able to detect B cell-derived EVs for further analysis and comparison between samples.

**Samantha Steeman**
Title: Heritability of the Broad Autism Phenotype
Supervisor: Dr. Edward Brodkin
Autism spectrum disorder (ASD) is a complex, phenotypically heterogeneous neurodevelopmental disorder characterized by deficits in social communication and restricted, repetitive behaviors (RRBs). ASD behaviors exist on a continuum in the general population. In the present study, probands with ASD and without intellectual disability (ID) and their extended family members complete quantitative behavioral phenotyping measures and undergo whole genome sequencing. While the heritability of ASD traits has been established, individual herit abilities of traits implicated in ASD remain largely unknown. We hypothesized that scores on measures of ASD traits (SRS, AQ, BAPQ), social cognition (SRS Cognition), social anxiety (LSAS), RRBs (SRS RRB, ABC Stereotypy), and executive functioning (BRIEF) would demonstrate heritability yin extended ASD pedigrees, but that ASD traits measured by SRS would confer higher heritability than other measures. We found that while all measures were significantly heritable, social anxiety was most heritable, followed by autistic traits, social cognition, and social motivation.

**Anita Kalluri**
Title: The Effect of Oxytocin and Ghrelin on Appetitive Food Seeking Behavior
Supervisor: Dr. Harvey Grill; Hallie Wald
The neuropeptides oxytocin and ghrelin are involved in energy balance control as central oxytocin reduces, and central ghrelin increases, food intake. Oxytocin and ghrelin affect feeding, in part, viain creases or decreases in food seeking behavior (my 399). However, investigations of both neuropeptides in appetitive feeding have been restricted to reward areas like the VTA, and the role of the hindbrain is unknown. This study uses behavioral and pharmacological techniques to investigate the hypothesis that hindbrain OT and ghrelin signaling affect food intake by modulating food seeking behavior. Results show that NTS OT delivery reduced food seeking behavior in a reinstatement paradigm, whereas hindbrain ghrelin had no effect. This highlights a role for the NTS in modulating OT-induced reductions in food seeking behavior, and suggests that hindbrain ghrelin modulates feeding behavior by a different mechanism.

**Lydia Maliackel**
Title: Early-life trauma increases rates of suicide ideation in adolescence with socioeconomic status and race acting differentially on this interaction while previous suicide ideation predicts future suicide attempts
Supervisor's: Dr. Ruben Gur and Dr. Ran Barzilay
Limited data exists on the relationship among different environmental adversities and their association with suicidal ideation (SI) in adolescence. Here, we studied the interaction of early-life trauma with SES and race in association with SI with the Philadelphia Neurodevelopmental Cohort (PNC) (N=7,054, age range 11-21). Exposure to traumatic stressful events (TSE) was assessed, and SES scores were calculated. Binary logistic regression models were used with SI as the dependent variable and trauma exposure, SES, race as independent variables. Low SES youths with high trauma exposure reported less SI to high SES counterparts. Unlike trauma's association throughout, low SES was associated with SI only in early adolescence. African-American youths with high trauma exposure reported less SI compared to their non-African-American counterparts. Lastly, we looked at the longitudinal effects and suicide attempts (SA). Trauma did not predict SA, but SI at time 1 did predict SA at time 2.

**Patrick Markwalter**
Title: In-Utero Opioid Exposure Alters Mouse Offspring Behavior and Communication
Supervisor's: Mariella De Biasi, PhD
Infants affected by neonatal opioid withdrawal syndrome (NOWS)often exhibit high-pitched calls of distress; the present study induces morphine withdrawal in mouse offspring of morphine-dependent mothers and assesses for changes in the ultrasonic vocalization properties of these mice relative to control offspring. It was hypothesized that morphine withdrawal would elicit more frequent and higher-pitched calls from the morphine pups relative to controls. The software Raven Pro 1.5.0 was used to identify calls to be analyzed using a mixed effects model. Analysis showed an overall effect of dam treatment on the average frequency, duration and number of calls in a five-minute interval, with morphine pups exhibiting higher-pitched, shorter and fewer calls than control pups. The mouse model of vocalization alterations recapitulates the vocalization phenotype observed in NOWS-affected human infants and provides translational implications by validating a rodent model for in-utero morphine exposure in mice that are self-administering morphine.

**Alexa Pisciotti**
Title: Involvement of BNST Neurons in Sleep and Emotional Balance
Supervisor: Dr. Shinjae Chung
Sleep quality and mental health are highly intertwined. This research investigates the Bed Nucleus of the Stria Terminalis (BNST), a brain region involved in this relationship, in relation specifically to the acute stress response. Through electrophysiology, immunohistochemistry, and optogenetics we are able to measure activity and selectively activate the region. Our findings show that c-Fos expression increases in the BNST following the acute stress protocol, indicating an increase in activity. Chemo genetical activation of the BNST also causes a reduction in REM sleep in mice. In line with this finding, optogenetic stimulation of the BNST projections to the locus coeruleus (LC) appears to reduce REM sleep; further experiments are necessary to confirm this finding. These results indicate that the BNST plays an important role in both the acute stress response and production of REM sleep, which represent key findings for future research into the interlaced concept of sleep and psychiatric dysfunction.

**Luis Felipe Carvao**
Title: Analyzing the Effect of Social Support on Cognitive Function, Abstinence Rates, and Withdrawal Severity in HIV+ Smokers
Supervisor: Dr. Rebecca Ashare
Smoking rates among people with HIV (PWH)are about three-times higher than in the general population. Traditional smoking-cessation paradigms have not been successful for PWH, demonstrating the need to understand the unique mechanisms driving their cigarette-seeking behavior. The initiation and perpetuation of tobacco use is influenced by interactions with social groups, and supportive behaviors specific to PWH remain unclear. Chronic smoking has been shown to increase risk for cognitive impairment. Impairments experienced during nicotine withdrawal seem to mirror those associated with HIV-infection, which may provide additional barriers to achieving abstinence for smokers with HIV. These factors contribute to the unique challenges that smokers with HIV experience, creating novel barriers during quit attempts. We will test whether lower levels of perceived positive social support exacerbate abstinence-induced cognitive deficits among smokers with HIV, and whether higher levels of perceived positive social support are associated with increased abstinence rates among smokers with HIV.

**Donnisa Edmonds**
Title: "Exploring the relationship between callous-unemotional traits and physiological sensitivity to emotionally evocative movie clips.
Supervisor: Dr. Rebecca Waller
Callous-Unemotional (CU) traits are defined by a lack of empathy and guilt. Children with CU traits are at risk for antisocial behavior, violence, and depression. This study investigated whether CU traits are underpinned by blunted physiological responses to emotion. The data came from 15 children (66.7% males; 53.3% African-American) recruited through the ongoing Family Child and Emotional Socialization (FACES) study. Children watched clips from the Lion King, while we collected RSP and EEG data. Parents reported on children's CU traits using the Inventory of Callous-Unemotional Traits, which has three subscales: callousness, uncaring, and unemotional. Preliminary results, based on smaller sample than planned due to COVID-19, were inconclusive, but there was a trend-level relationship between higher unemotionality and decreased physiological response to sad video clips. The results suggest that

**Christopher Muracca**
Title: The Color Coherence Illusion:Similarly Colored Arrays Appear More Numerous
Supervisor's: Dr. Elizabeth Brannon and Dr. Nicholas DeWind
Several non-numerical attributes of elements have been found to affect numerical estimation of visual arrays, including the average spacing of items, connectedness, arrangement, and size. Previously, a coherence illusion was found in which an array with coherent orientation (objects all pointing in the same direction) appears more numerous than an array with randomly orientated objects. Here, a similar paradigm was implemented with arrays of single and variably colored dots to determine whether the coherence effect is specific to orientation or the result of a more general mechanism. We found that subjects are susceptible to the color coherence illusion: they estimate arrays of one color to be more numerous than arrays of multiple colored dots. Both color and orientation seem to be different examples of the same more general effect of object coherence. While this finding is not predicted by any current model of numerical estimation, entropy may provide an explanation.

**Saarang Karandikar**
Title: 3D-Printing of Micro-Tissue Engineered Neural Networks for Brain-Machine Interfaces
Supervisor/PI: D. Kacy Cullen, PhD
Brain-machine interfaces have become a holy grail in neuroscience due to their capacity to restore motor function, and thus independence, to victims of neurological trauma or degeneration. Due to limitations in inorganic electrode biocompatibility, however, the Cullen laboratory began development of micron-scale tissue engineered neural networks (micro-TENNsor UTs) in order to create fully biocompatible "bio-electrodes" from neuronal explants. While the efficacy of these electrodes in rat cortex has been proven, a novel uT fabrication process has become necessary due to current limitations on uT length and yield/reliability. Here, we describe and partially demonstrate the creation of a novel, fully automated,3D-bioprinting driven process for the production of micro-TENNs. To date, proof of concept prints have shown the ability to autonomously print uT casings at ~2x relevant scales via the FRESH technique. Ongoing work will miniaturize the process and compare the neuronal properties of manually and autonomously produced UTs.

**Dominique Nicole Martinez**
Title: Neural Basis of Persistence in Young Children
Supervisor: Allyson Mackey, Ph.D.
Persistence in the face of challenge is important for learning. However, we know very little about the circuitry supporting persistence in young children. Here, we used resting-state fMRI (rsfMRI) to explore the neural correlates of parent-reported trait persistence in 4-10-year-olds (n = 67). Behaviorally, we found that persistence increases with age and does not differ by socioeconomic status. Inspired by rodent and human adult work exploring the neural basis of effort, we tested how the connectivity of subcortical regions associated with cognitive control (caudate nucleus), reward (ventral tegmental area, nucleus accumbens), and emotion regulation (amygdala) measured at rest related to children's trait persistence. We found that higher trait persistence was related to stronger caudate to ventrolateral prefrontal cortex connectivity, regardless of stress exposure and socioeconomic status. Ongoing analyses are exploring how the neural correlates of persistence might differ by early life experiences.

**Mikaela Glass**
Title: Investigating the Significance of the Anatomical Divergence of Prefrontal Afferent Projections between the Anterior and Posterior Regions of the Dorsal Medial Striatum
Supervisor's: Marc Fuccillo, M.D, Ph.D Mentor: Kyuhyun Choi, Ph.D
The dorsal medial striatum (DMS) is a central region involved in goal-directed decision-making,and corticostriatal inputs from the medial prefrontal cortex (mPFC) contribute to this functionality. Previous research has suggested that the anterior and posterior regions of the DMS may demonstrate functional divergence and parallel processing during associative learning based on different sensitivities to manipulation. We hypothesized that the majority of synaptic inputs from the mPFC targeted distinct neuronal populations of the aDMS and pDMS in non-overlapping pathways to mediate functional specificity. Retrograde labeling of circuits was accomplished with trans-neuronal monosynaptic tracing via aΔG pseudo-rabies virus, EnvA-RV(ΔG)-eGFP, and CTB647 in mice. Confocal immune fluorescence imaging of the distribution of labeled cell bodies within cortical layers 2/3 demonstrated a lack of convergence of synaptic inputs between the striatal regions.Reversal learning trials with mPFC-aDMS or mPFC-pDMS pathway-specific manipulations and mini scope investigations of coding properties could not be completed prior to lockdown.

11:30 **Lunch/posters on BBB399 Canvas**

# 399 & 499

## POSTER PRESENTATIONS

# 399 Poster Presentations

**Danielle Harris**
Phopsho-C-Jun as a predictive marker of chronic and progressive neurodegeneration following a mouse model of TBI
Supervisor: Victoria E. Johnson, Ph. D, MBChD
Many neuronal stressors, including traumatic axonal injury (TAI), have been shown to induce c-Jun activation via phosphorylated Jun-kinase (pJNK). Following traumatic brain injury (TBI), axons are incredibly susceptible to acute injuries, which often disrupt transportation retrogradely and anterogradely. These injuries can then have persisting effects, including brain atrophy and behavioral deficits. To explore the extent of this pathology on a chronic timescale using a cortical controlled impact (CCI) model of TBI in mice, tissue sections were stained for phoshpho -c-Jun and other markers related to neuronal stress, axonal damage and apoptotic death. As time after injury progresses, areas which were highly positive for phospho-c-Jun go on to dramatically vanish. Therefore, we predict that phospho-c-Jun immunoreactivity as a result of axonal damage indicates impending atrophy. By using various survival timepoints and staining with phospho-c-Jun and a marker for cell degeneration, the intent is to characterize the progression from damage to death.

**Mary Webb**
Title: Investigating the role of the Medial Habenula in the Co-abuse of Nicotine and Opioids
Supervisor: Mariella De Biasi
Given the current opioid epidemic, the concurrent rise in e-cigarette popularity, and the fact that ~85% of opioid-dependent people also use nicotine, further investigation into the relationship between the two classes of drug is critical. Though historically neglected in literature, the medial habenula (MHb), a bilateral epithalamic structure, received recent attention for its proposed role in addiction to almost all drugs classes, including nicotine and opioids. With a high density of both mu-opioid receptors and nicotinic receptors, the MHb likely plays a critical role in the nicotine-opioid codependency. Mice were exposed to nicotine via e-cigarette vapor delivery and morphine via 2-bottle choice paradigm for 8 weeks to establish drug dependence. Following the drug treatment, mice underwent spontaneous drug withdrawal, during which physical signs of withdrawal were quantified. Each withdrawal paradigm was capable of producing drug dependence and increased somatic signs of withdrawal correlated to peak withdrawal time points withdrawal.

**Allison Dreier**
Development of a mouse model to study the effects of adolescent vaping of Δ-9-tetrahydrocannabinol (THC)
Supervisor's: Allison Dreier, Theresa M. Patten, Ajinkya Sase, PhD, Elizabeth Heller, PhD, Mariella De Biasi, PhD
Cannabis is the most frequently used illicit drug in the world. With increased e-cigarette cannabis use, it is increasingly important to establish preclinical models to study cannabis use in adolescence and to understand its potential effects on the developing brain. The present study utilized an SVS200 e-cig vapor machine (La Jolla Alcohol Research, Inc.) to deliver vaporized e-liquid containing Δ-9-tetrahydrocannabinol (THC) (100 or 200 mg/ml THC vapor) to adolescent C57/BL6J mice of both sexes. Mice exposed to THC via e-cigarette vapor show dose-dependent effects in both physiological endpoints (e.g. subcutaneous body temperature and locomotor activity) compared to controls (PG vapor only) and THC is detectable in their serum via ELISA assay. Molecular analyses detected the histone expression pattern in THC-exposed compared to vehicle-exposed animals. By using commercially-available products, this study establishes a highly translational method to study THC vaping in adolescents, which is a rising epidemiological concern.

**Mallory Harrower**
Title: The Role of Nr4a1 in Drug-Associated Behavior and Memory
Supervisor: Dr. Elizabeth A. Heller
Following cocaine addiction, drug-induced neuroplasticity triggers endogenous homeostatic mechanisms to restore normal brain function. Carpenter et al. performed a murine analysis of global transcriptomic changes in the nucleus accumbens that revealed Nr4a1as a regulator of neuronal suppression following hyperexcitation. Succeeding the self-administration of cocaine, a transgenic modification for the up-regulation of Nr4a1during abstinence was sufficient in diminishing cocaine seeking and self-administration. Nr4a1has known expression in learning, long-term potentiation, control of spine density, long-term memory, and activation of hippocampal target genes. In humans, the self-administration of drugs creates an association between drug effect and place and paraphernalia, suggesting a molecular relationship between drug-memories and drug-seeking behavior. This research review reveals the compartmental regulation of Nr4a1 in the nucleus accumbens, hippocampus, and medium spiny neuronal projections that allows the consolidation of memory to suspend cocaine seeking behavior.

# 499 Poster Presentations

**Jae Yoon**
Title: Stress-Induced Effects on the Level of Pituitary Adenylate Cyclase-Activating Polypeptide-27 (PACAP-27) in the Paraventricular Nucleus of the Thalamus
Supervisor: Dr. Seema Bhatnagar
The paraventricular nucleus of the thalamus (PVT) has been suggested to modulate the neuroendocrine and behavioral response to chronic stress. The PVT is also known to influence in ethanol (EtOH) drinking behavior. The levels of neuropeptide, pituitary adenylate cyclase-activating polypeptide (PACAP)-27, which has been suggested in regulating feeding behavior and the sympathetic response, are increased in cells of the PVT following pharmacologically relevant EtOH drinking. However, the association between social stress and the influence of PVT on EtOH drinking remains relatively unknown. From previous research, the age and sex in social stress influenced the induced neuronal activity localized in the PVT. Thus, we predict that the age and sex will also influence the level of PACAP-27. Through DAB staining, we examined how stress-induced effect change the expression of PACAP-27 in the PVT.

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**Group 1**

Lori Flanagan-Cato
Jennifer Heerding
Mike Kaplan

**Group 2**

Marc Schmidt
Judith McLean
Mike Kane

12:15 **Session 3 (call into zoom rooms to set up)**

**Zoom Room 1**

**Session 3**
12:30 Geena Jung
12:45 Howard Li
1:00 Nicholas Paleologos
1:15 Jamie Galanaugh
1:30 Paul Um

**Zoom Room 2**

12:30 Jae Yoon
12:45 Alexander Farid
1:00 Xin (Jessica) Liu
1:15 Sabina London
1:30 Chad Vigil
1:45 Grace Wu

**Geena Jung**
Title: The Role of Repulsive Guidance Signaling in Pediatric Low-Grade Gliomas
Supervisor: Dr. Yuanquan Song, Department of Pathology and Laboratory Medicine
Pediatric low-grade gliomas (PLGGs) are common brain tumors affecting children and often require multiple treatments, including surgical intervention and chemo therapy. Despite its prevalence, the underlying pathogenesis of PLGGs is not well understood. We have thus established a novel fly tumor model through glial over expression of QKI-RAF1, a PLGG patient-derived fusion gene. QKI-RAF1 induces glia over-proliferation and abnormal migration. We hypothesized that the repulsive guidance signaling pathway, a pathway associated with glia migration, may be impaired in the PLGG model. We found that overexpression of the guidance receptors Robo2 and Plex A/B in glial cells was able to ameliorate the migration defect induced by QKI-RAF1. Furthermore, Robo2 was significantly down-regulated in the glial cells that aberrantly migrated. Taken together, our findings suggest that the repulsive guidance signaling pathway is hijacked in the tumor model and may be a potential therapeutic target in PLGG treatment.

**Howard L. Li**
Title: Tau pathology spreads between anatomically-connected regions of the brain and is modulated by a LRRK2 mutation
Supervisor: Dr. Virginia Lee (PI) and Dr. Michael Henderson (Research Mentor)
Mutations in leucine-rich repeat kinase 2 (LRRK2) are present in 4% of familial and 1% of sporadic Parkinson's disease patients, making them the most common cause of familial PD. However, the role that LRRK2 plays in PD pathogenesis is unclear. Of PD patients with a LRRK2 mutation, approximately 79% have classic α-synuclein-containing Lewy bodies. Remarkably, 90% or more of LRRK2 mutation carriers exhibit tau pathology of varying degrees, in a similar distribution to that seen in idiopathic PD. The presence of tau pathology is significant because tau burden is associated with cognitive decline in PD patients. In this study, we use either wildtype mice or a mouse model carrying a LRRK2 mutation to investigate the spread of tau pathology. We find that tau pathology spreads through anatomically-connected brain regions in a predictable spatiotemporal pattern, and that LRRK2 mutations alter patterns of pathology spread.

**Nicholas Paleologos**
Title: 3D In Vitro Model of Traumatic Brain Injury-Induced Neuroinflammation
Supervisor: D. Kacy Cullen, PhD
Traumatic brain injury (TBI) is a major cause of morbidity in the United States. TBI-induced neuroinflammation presents a complex etiology and has been shown to produce further complications in patients. Our study aims to probe the neurobiological changes resulting from interactions between injured neurons and reactive glia after TBI. In order to recapitulate the neuronal environment tin vitro, an extracellular matrix-based 3D scaffold was used to support co-cultures and tri-cultures comprised of primary cortical rat neurons, astrocytes, and microglia. Overall, 3D constructs exhibited high viability, low cytotoxicity, integration of multiple cell types, and network formation. After maturation, these constructs will be subjected to injury produced by a cell shearing device with controllable strain rates. We hope to use this model to investigate pathology, aberrant glial activity, and cell loss a rising from TBI. Future experiments will elucidate the effect of injury on the phenotypes and activities relevant to each cell type.

**Jamie Galanaugh**
Title: Using Migratory Interneurons as Therapeutic Vectors for Glioblastoma
Supervisor: Stewart AndersonABSTRACT:Glioblastoma Multiforme(GBM) is an aggressive brain tumor type whose highly proliferative characteristics are attributed in part to an overexpression of stromal cell-derived factor 1 (SDF-1), which interacts with chemokine receptor C-X-C chemokine receptor type 4 (CXCR-4) within the tumor microenvironment to mediate vascularization and invasion. Since the SDF-1/CXCR4 signaling pathway is known to be a powerful chemoattractant for the migration of cortical inhibitory interneurons (INs) during brain development, we hypothesized that IN transplants would migrate toward GBMs known to express SDF-1. To test this hypothesis, we injected U87 GBM cells into NU/J mice, transplanted INs following tumor growth, and histologically assessed IN migration. IN migration to tumor margins was observed in support of our hypothesis. We are continuing experiments with other GBM lines and would like to utilize INs to inducibly express factors that would block tumor growth/vasculature at GBM margins which ultimately may improve treatment.

**Paul Um**
Title: Orsay Virus Infection Alters Thermotactic Behavior and Induces Sleep through flp-13 Signaling in Caenorhabditis elegans Nematodes
Supervisor: David Raizen. Department of Neurology
Common symptoms of sickness include nausea, fatigue, social withdrawal, headache, fever, and increased sleep drive. Here I investigate the mechanism of fever and increased sleep. Caenorhabditis elegans provides a powerful model for studying the mechanism of fundamental physiological processes. As a poikilothermic animal, it regulates internal temperature behaviorally, by moving to a preferred temperature. However, it was unknown whether C. elegans mounts a behavioral fever. I performed thermotaxis experiments to test if worms mount a behavioral fever by moving to higher temperatures. I found that animals infected with the Orsay virus worms favored higher temperatures, suggesting that viral-infection alters thermotactic behavior. Studying the mechanism of survival benefit of virally induced sleep, we tracked the lifespans of various worm strains with altered sleep behavior. Sleepless mutants had accelerated mortality rates, and animals with restored sleep due to over-expression of sleep-inducing neuropeptides encoded by the gene flp-13 had restored survival curves. In contrast to over-expression of flp-13, which conferred a survival benefit during viral infection, animals over-expressing the somnogenic gene nlp-8 had a reduced lifespan. My data are the first to suggest that C. elegans mounts a behavioral fever. It also suggests that sleep is beneficial to survival during sickness.

**Jae Yoon**
Title: Stress-Induced Effects on the Level of Pituitary Adenylate Cyclase-Activating Polypeptide-27 (PACAP-27) in the Paraventricular Nucleus of the Thalamus
Supervisor: Dr. Seema Bhatnagar
The paraventricular nucleus of the thalamus (PVT) has been suggested to modulate the neuroendocrine and behavioral response to chronic stress. The PVT is also known to influence in ethanol (EtOH) drinking behavior. The levels of neuropeptide, pituitary adenylate cyclase-activating polypeptide (PACAP)-27, which has been suggested in regulating feeding behavior and the sympathetic response, are increased in cells of the PVT following pharmacologically relevant EtOH drinking. However, the association between social stress and the influence of PVT on EtOH drinking remains relatively unknown. From previous research, the age and sex in social stress influenced the induced neuronal activity localized in the PVT. Thus, we predict that the age and sex will also influence the level of PACAP-27. Through DAB staining, we examined how stress-induced effect change the expression of PACAP-27 in the PVT.

**Alex Farid**
Title: Olfactory fMRI in Awake-Behaving Mice
Supervisor: Dr. Jay Gottfried
In the field of olfaction, literature regarding odor-induced glomerular activation patterns remains relatively limited. This study observed odor-specific glomerular activation via functional MRI (fMRI) in awake-behaving mice. Mice were trained over six-to-eight weeks to discriminate between two distinct odors, benzaldehyde and acetophenone, through a robust two-alternative-forced-choice paradigm (2AFC). Once mice reliably discriminated between and responded to each odor (<80% correct response rate), they were scanned via fMRI while performing the 2AFC task. While being scanned, mice were able to discriminate between odors with over 90% accuracy. Data analyses include: tracking improvement in task accuracy, enhancement of odor delivery timing via photoionization detector analysis, understanding changes in respiration rate in the presence and absence of each odor, and deciphering brain activation patterns via fMRI. Collectively, this information provides a more comprehensive understanding of glomerular activation patterns triggered by specific odorants, ideally illuminating new avenues for translation to the human olfactory system.

**Xin (Jessica) Liu**
Title: Neonatal opioid exposure and development of negative affect
Supervisor's: Dr. Julie Blendy and Dr. Amelia Dunn
Opioid use among pregnant women is a significant public health concern. This study uses a mouse 3-trimester exposure model to analyze the long-term behavioral consequences of morphine exposure and withdrawal on mothers and their offspring. Morphine-treated female pups consumed significantly more water and sucrose than saline-treated females in a Sucrose Consumption Test and morphine-treated females spent significantly more time immobile than saline-treated females in the Tail Suspension Test. Male and female morphine-treated pups also showed non-significant increases in the development of learned helplessness. Together these results indicate an increase in anxious and depression-like behaviors in adults following early-life opioid exposure. We also wanted to determine the impact of opioid exposure during pregnancy on mothers of these offspring. Of interest, we found that opioid exposure did not significantly alter affective behavior 24 hrs following withdrawal. Future studies examining additional behavior phenotypes and later time points are in progress.

**Sabina London**
Title: Understanding the Role of the Female Song System in the Regulation of Courtship Behavior through Immediate Early Genes
Supervisor: Dr. Marc Schmidt
Songbirds are an ideal model system for the study of vocal learning and reproductive behavior. While the song system has mostly been studied in the context of song production, our objective is to understand the role of the song system in courtship behavior. Our hypothesis is that the song system in females regulates the production of a copulation solicitation display (CSD) or mating posture behavior. To identify brain regions involved in CSD production, I plan to examine expression of Arc, an immediate early gene that is expressed in response to neuronal activation. Much remains unknown regarding the precise neural circuitry underlying the regulation of courtship behavior, and I will use this novel approach involving immediate early genes to investigate the degree to which the song system is activated during CSD behavior.

**Chad Vigil**
Title: "Analysis Following Perturbation of Viscerosensory Feedback"
Supervisor: Dr. Marc Schmidt
Song production from the male zebra finch (Taeniopygia guttata) is highly stereotyped, and thus easy to study and analyze. This song production relies on an internal song circuit, which receives inputs from the periphery in order to maintain this stereotyped song. With this in mind, we have observed through previous research that nucleus HVC within this song circuit responds to viscero sensory feedback in anesthetized birds, however, research has not yet been done involving these recordings in active singing birds. In order to investigate this, precise puffs of air were to be administered via a surgically implanted cannula into the air sac of a singing finch while recording from nucleus HVC. These puffs were to be triggered directly by a specific "syllable" used in their song motif using a program called, EvTAF. Utilizing EvTAF, templates were created for select finches and a cannula was successfully implanted into one of these finches.

**Grace Wu**
Title: Developing an in vitro Model of the Dendritic Cytoskeleton
Supervisor: Dr. Erika Holzbaur
In neuronal dendrites, complex actin filament (AF) and microtubule (MT)-based cytoskeletal networks remodel in response to stimulation. More specifically, MTs in the postsynaptic dendritic shaft are signaled to invade into AF-dense spines, creating regions of significant MT/AF overlap which modulate cargo trafficking into spines and enhance synapse plasticity. Given the complexity of whole cells, in vivo live-cell imaging techniques lack the spatial and temporal resolution to resolve the mechanisms that regulate transport at these cytoskeletal intersections. Therefore, we aim to understand the mechanism by which cargos are selected for transport into spines by developing an in vitro model of the dendritic cytoskeleton. To do so, we are engineering a micropatterned system where dynamic MTs invade a dense AF meshwork, as observed in vivo. Ultimately, these patterned cytoskeletal filaments will be used as tracks to observe the procession of vesicle-bound myosin and kinesin motors within regions of high MT/AF overlap.

***ALL are Welcome!***

***Biological Basis of Behavior***

*Class of 2020*

***Virtual Graduation Reception***

*Saturday, May 16, 2020*

*11am-12pm*


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