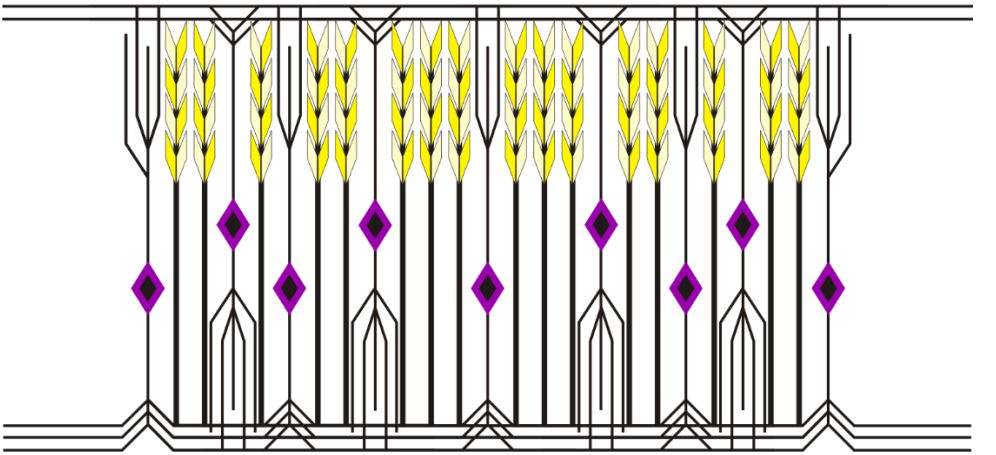
MIDBRAINS



2018

Midwest Regional Undergraduate
Research Symposium in Neuroscience

Final Program and Abstracts

Saturday, October 13

UNIVERSITY OF St.Thomas

1 Free Parking (lots M,N,O,V)
2 Paid parking (Anderson Parking Facility)
3 Anderson Student Center (ASC)
4 Murray-Herrick Campus Center (MHC)

PROGRAM AND SCHEDULE OF EVENTS

TIME	ACTVITY	LOCATION
8:00 am – 9:00 am	Registration	ASC 340
	Poster Installation	ASC 378N
	Breakfast	ASC 378S
9:00 am – 10:15 am	Welcome and Keynote Address **Rebooting the Growth Machinery: Gene Therapy Approaches to Spinal Cord Injury** **Murray Blackmore, PhD** *Marquette University*	ASC 378S
10:15 am – 10:30 am	Coffee Break	ASC 378S
10:30 am - 11:30 am	Graduate School Panel	ASC 378S
11:30 am - 12:30 pm	Lunch - Faculty	ASC 364
	Lunch - Students	The View (ASC 2nd Floor)
12:45 pm - 2:10 pm	Graduate Research Talks	MHC 204 MHC 205 MHC 206 MHC 207
2:30 pm - 4:30 pm	Poster session Graduate and Career Fair	ASC 378N

GRADUATE PROGRAM RESEARCH TALKS

MHC 204 *(room host: Roxanne Prichard)*

12:45: Acute stress modulates decision-making: Neural, neuroendocrine, and psychophysiological correlates. *Anthony Porcelli, Marquette University*

1:15: Chronic variable stress disrupts reward encoding and motivated behavior. *Mitchell Spring, Marquette University*

1:45: Organic cation transporter 3 – Gateway to nuclear membrane adrenergic receptors? *Kelsey Benton, Marquette University*

MHC 205 *(room host: Kurt Illig)*

12:45: Using graph theory to understand recovery from brain surgery. *Carolina Deifelt Streese, University of Iowa*

1:15: Live-cell imaging in neuronal cell models of psychiatric disease. *Aislinn Williams, University of Iowa*

1:45: Cerebellar abnormalities in the prickle2 mouse model of autism-like behavior. *Parker Abbott, University of Iowa*

MHC 206 *(room host: Jessica Siegel)*

12:45: A new look at the addicted brain: Combining neuroscience and economics in mice, rats, and humans. *Brian Sweis, University of Minnesota*

1:15: Tripartite synapses: Astrocyte roles in brain function. *Alfonso Araque, University of Minnesota*

1:45: Building the mammalian brain- how do we get the right number of neurons at the right time and location? *Yasushi Nakagawa, University of Minnesota*

MHC 207 *(room host: Sarah Hankerson)*

12:45: Tiring from trying: A potential relationship between errors in motor control and post-stroke fatigue. *Lee Baugh, University of South Dakota*

1:15: The Science of Sweet: The Effect of Artificial Sweetener on Neurological and Behavioral Responses in a Delay Discounting Task. *Kelene Fercho, University of South Dakota*

1:45: Neurovascular signaling mechanisms of erythropoietin. *Neeraj Tiwari, University of South Dakota*

GRADUATE RESEARCH TALK ABSTRACTS

MHC 204 12:45 – 1:05

Acute stress modulates decision-Making: Neural, neuroendocrine, and psychophysiological correlates

Anthony Porcelli, Marquette University

Much recent research has focused on the influence of acute stress over cognitive, affective, and social processes. As a construct decision-making represents a complex interaction between all three, and thus may be subject to modulation by the biological correlates of the stress response at multiple levels. In this presentation the focus will be on an exploration of the nature of the stress response, and research examining the potential for acute stress-related neural, neuroendocrine, and psychophysiological dynamics to alter decision-making via their influence over exemplar cognitive, affective, and social processes.

MHC 204 1:15 – 1:35

Chronic variable stress disrupts reward encoding and motivated behavior

Mitchell Spring, Marquette University

The nucleus accumbens (NAc) has long been known to play a critical role in both hedonic processing and motivation and is likely involved in the development of depression-relevant symptoms. Recent reports have detailed disruptions in NAc function and its dopaminergic input that are correlated with altered reward sensitivity in stress models of depression. To study the effect of stress on the encoding of primary rewarding and aversive stimuli by NAc neurons, adult male Sprague Dawley rats were implanted with intraoral catheters for tastant delivery and stainless steel microwire electrode arrays targeting the NAc core and shell for electrophysiological recordings. Single unit firing rates were recorded in response to intraoral infusions of sucrose and quinine both before and after a 14 day chronic variable stress (CVS) paradigm. Units were classified as excited, inhibited, or unaltered by the tastant infusion. A taste reactivity analysis of orofacial responses reflective of the hedonic perception of the tastants was performed offline. Consistent with prior studies, intraoral infusion of sucrose was found to reduce the firing rates of most responsive NAc neurons (68% inhibited, 32% excited). CVS experience reduced the number of neurons inhibited by sucrose in the shell of the NAc (48% inhibited, 52% excited). Such inhibitory responses are typically associated with hedonic behavioral responses. However, following CVS, animals did not show a corresponding decrease in appetitive taste reactivity. Since hedonic perception appeared to be unchanged, we hypothesized that the altered encoding of sucrose could result in a disruption in the ability of rewarding stimuli to guide motivated behavior. This was tested with a Pavlovian autoshaping task in which the presentation of a CS+ or CS- lever predicted the delivery of a sucrose pellet or no reward delivery, respectively. Animals rapidly acquired a learned interaction with the CS+ lever. However, CVS experience delayed acquisition and produced reduced approach even after acquisition. Together, these data indicate that chronic stress alters the encoding of primary reinforcers in a manner that disrupts their ability to incentivize behavior. Ongoing experiments are examining the role of prefrontal cortical input to the NAc in this process using fiber photometry.

MHC 204 1:45 – 2:05

Organic cation transporter 3 – Gateway to nuclear membrane adrenergic receptors?

Kelsey Benton, Marquette University

The conventional model of adrenergic signaling involves activation of plasma membrane receptors, followed by G-protein-mediated signaling within the cytoplasm. However, recent studies have demonstrated that adrenergic receptor signaling can be initiated at intracellular membranes, including the nuclear membrane. Recently, we observed the expression of β1 adrenergic receptors, and critical G-protein signaling actors in the nuclei of cultured mouse astrocytes. Furthermore, we have demonstrated that organic cation transporter 3 (OCT3), a catecholamine transporter, is localized to the outer nuclear membrane, suggesting that OCT3 allows norepinephrine to access nuclear adrenergic receptors. These observations indicate that nuclear membrane receptors may be an important component of adrenergic signaling in the central nervous system. In a series of experiments, we have sought to determine the function of nuclear and plasma membrane adrenergic receptors. Using nuclear fractionation and western blot analysis, we confirmed the predominant localization of β1 receptors to the nuclei of astrocytes. Immunofluorescence studies using two different detergents to permeabilize the plasma (digitonin) or plasma and nuclear (triton X-100) membranes revealed localization of key G-protein signaling components in the nuclei of astrocytes. To assess the function of this signaling system, we transfected primary astrocytes with a genetically engineered FRET sensor based upon Exchange Protein Activated by cAMP (Epac) to examine real-time fluctuations in cAMP in response to adrenergic agonists. We observed a robust increase in nuclear cAMP in response to norepinephrine and the β-selective agonist isoproterenol. This signal is blocked by the β-selective antagonist propranolol. Future research will determine whether activation of nuclear adrenergic receptors is gated by outer nuclear membrane catecholamine transporters, and whether blocking uptake could limit nuclear adrenergic activation.

MHC 205 12:45 – 1:05

Using graph theory to understand recovery from brain surgery

Carolina Deifelt Streese, University of Iowa

Surgical removal of brain tissue is an elective procedure for patients with medication-resistant epilepsy, requiring patients to make challenging decisions considering the risks and benefits of this invasive procedure. Although surgery is a highly effective treatment, cognitive consequences are possible; 44% of patients with left mesial temporal lobe epilepsy experience a significant decline in verbal memory following resection. While pre-surgical predictors of seizure outcome and their putative mechanisms have been appreciably established, predictors of cognitive outcomes are less well-established and the underlying mechanisms are largely unknown. One possible mechanism underpinning cognitive outcomes may be changes in network connectivity. The present research proposes to quantitatively assess changes in whole-brain and lesion-derived networks during the recovery period following anterior temporal lobe (ATL) resection and examine how these changes relate to verbal memory outcomes. We acquired resting state fMRI data on patients undergoing ATL resection as treatment for medication-resistant mesial temporal lobe epilepsy (n=6, 4 left-sided) prior to surgery, and during the acute (1-3 months post-surgery) and chronic (more than 6 months post-surgery) recovery epochs. These data were used to generate networks and analysed using a graph theoretical approach. Verbal memory outcomes were assessed using the Rey Auditory Verbal Learning Test both pre-surgically and during the chronic epoch. A full understanding of how brain regions involved in verbal memory form networks, how these networks change during recovery, and the relationship between network changes and cognitive outcomes may allow us to better understand cognitive decline following resection, thus affording patients the opportunity to make more informed decisions surrounding surgery as well as guiding future therapies and interventions.

MHC 205 1:15 – 1:35

Live-cell imaging in neuronal cell models of psychiatric disease

Aislinn Williams, MD, PhD, University of Iowa

Bipolar disorder (BD) is a complex neuropsychiatric disorder associated with episodes of altered mood, energy, and sleep. The molecular and cellular mechanisms of BD are poorly understood. Patient-derived induced pluripotent stem cells (iPSCs) provide a model for studying neurodevelopment in BD, which may help uncover disease mechanisms. Variation in the gene CACNA1C, which encodes the voltage-gated calcium channel CaV1.2, confers increased risk for BD and other psychiatric disorders. Therefore, we used both iPSCs and mouse primary neurons to investigate calcium signaling dynamics related to CACNA1C. We reprogrammed fibroblasts from neurotypical controls (CTL) and BD patients into iPSCs, and differentiated them into neurons and astrocytes. We used fluorescent calcium indicators to identify differences in calcium signaling between developing BD and CTL neurons and astrocytes. We also examined the role of CaV1.2 in calcium dynamics using CaV1.2 knockout mouse neurons. Our results suggest that CaV1.2 is differentially distributed across neuronal compartments, and its contribution to neuronal calcium signaling varies with the activity induction paradigm used. We are currently using iPSC and mouse models to investigate the how variation in the CACNA1C gene alters neuronal differentiation and function throughout development in BD as well as other neuropsychiatric disorders.

MHC 205 1:45 – 2:05

Cerebellar abnormalities in the prickle2 mouse model of autism-like behavior

Parker Abbott, University of Iowa

Autism spectrum disorders (ASD) involve abnormalities across brain systems, resulting in a constellation of symptoms including behavioral inflexibility, cognitive dysfunction, learning impairment, altered social interactions, and perceptive time difficulties. Recently, it was discovered that a common gene variant involved in non-canonical Wnt signaling, prickle2, was present in a subset of individuals with ASD. Corroborated findings in prickle2 knock-out and heterozygous mice suggest patterns of behavior similar to individuals with ASD including altered social interaction on the three-chambered social task and behavioral inflexibility on the Barnes maze. Additionally, prickle2 disruption results in hippocampal neuronal abnormalities including reduced dendritic branching, synapse number, and post-synaptic density size. Prickle2 is strongly expressed in Purkinje cells. Our preliminary results indicate that there is a decrease in calbindin binding in cerebellar Purkinje cells. The canonical way to investigate cerebellar function in animals is using cerebellar dependent eyeblink conditioning. We hypothesize that if the cerebellum is abnormal in autism and in the Prickle2 animals, we will see impaired learning and/or expression of eyeblink conditioning. We examined eyeblink conditioning in prickle2-disrupted mice using a 275-millisecond light cue conditioned stimulus with a co-terminating 50 millisecond shock to the eyelid muscle as the unconditioned stimulus. Preliminary data suggest that prickle2-disrupted mice may have impaired acquisition of eyeblink conditioning while there are no significant impairments on a battery of motor tasks suggests. Additionally, we explored structural and physiological abnormalities in animals with prickle2 disruption using immunohistochemistry and whole-cell patch clamp recordings in Purkinje cells. These data will illuminate if Prickle2 animals have impairments in Purkinje cell structure and function and how these abnormalities may contribute to impairments in cerebellar dependent eyeblink conditioning.

MHC 206 12:45 – 1:05

A new look at the addicted brain: Combining neuroscience and economics in mice, rats, and humans

Brian Sweis, University of Minnesota

How we make decisions is not so straightforward. How those decisions go awry is even more complicated. Imagining the future when deliberating is a complex process in the brain. Unique memories must be accessed. Hypothetical scenarios must be assembled. Multiple simulations must be evaluated and compared. Sometimes, decisions can be made using other strategies altogether. And sometimes, our decisions defy reason. Neuroeconomics is the study of how the brain computes these different aspects of what gets factored into a decision. My research dives deep into the neural mechanisms underlying these hidden aspects of decision making. We discovered that separate neural circuits are involved in distinct ways the brain calculates value. When considering the different lasting brain changes known to occur in psychiatric disorders like addiction, vulnerabilities to relapse could therefore arise from fundamentally distinct decision-making disruptions. Thus, novel treatments for addiction may benefit from interventions tailored to an individual's unique circuit-specific dysfunction. We use a translational approach across species taking advantage of the different research tools available in mice, rats, and humans. The goal of our work is to accelerate the development of improved circuit-based therapies for patients struggling with addiction.

MHC 206 1:15 – 1:35

Tripartite synapses: Astrocyte roles in brain function

Alfonso ARAQUE, University of Minnesota

Astrocytes, a type of glial cells, are recognized as key supportive elements in neuronal function, providing structural and metabolic support for neurons, and controlling brain homeostasis mechanisms. Historically, they were ignored as being active players in cellular processes underlying brain function. However, accumulating evidence indicate that astrocytes and neurons establish bidirectional communication. Astrocytes respond to synaptically-released neurotransmitters and, in turn, release gliotransmitters that influence neuronal and synaptic activity. This evidence has led to the establishment of the tripartite synapse concept, a novel view of synaptic physiology in which astrocytes are integral elements involved in synaptic function. I will present and discuss current evidence revealing the mechanisms and functional consequences of astrocyte-neuron signaling. I will discuss how this evidence supports a paradigm shift in our understanding of the cellular basis of brain function, which would result not solely from the neuronal activity, but from the coordinated activity of astrocytes and neurons.

MHC 206 1:45 – 2:05

Building the mammalian brain- how do we get the right number of neurons at the right time and location?

Yasushi Nakagawa, University of Minnesota

The mammalian brains are enormously complex; our brains have billions of neurons in thousands of different flavors. Yet they are assembled in an orderly manner and have specific connections with each other. Functions of the adult nervous system are built on the surprisingly sophisticated developmental mechanisms that allow generation and specification of these neurons and the establishment of their functional connectivity. Our lab is using genetic methods to study the development of the thalamus and the neocortex, the two reciprocally connected brain regions that play an essential role in nearly all brain functions. I will present our recent work on how these brain regions assemble distinct types of neurons in temporally and spatially regulated manners during early phases of mouse development.

MHC 207 12:45 – 1:05

Tiring from trying: A potential relationship between errors in motor control and post-stroke fatigue

Lee Baugh, University of South Dakota

For up to 75% of stroke survivors, fatigue in daily life contributes to a lower quality of life, is associated with a higher risk of death, and is ranked by stroke survivors and health professionals as one of the top 10 research priorities relating to life after stroke. With over 610,000 Americans experiencing a first-incident stroke each year, and more than one-third of stroke survivors identifying that fatigue interferes with daily activity, the cause of fatigue following stroke is of paramount importance. To date, models of fatigue in post-stroke patients have been developed that include biological, psychosocial, and behavioral factors. Based on these models, meta-analyses have shown that physical impairments in post-stroke survivors are a significant factor in the development and maintenance of post-stroke fatigue. Currently, there is little understanding as to the causal link between physical impairment and the development of post-stroke fatigue. The presented research examined the relationship between upper-extremity motor deficits in skilled object manipulation and the development of post-stroke fatigue. We predicted that those participants displaying deficits in skilled object manipulation, as assessed through novel object-interaction tasks, would be more likely to report fatigue due to the increased mental workload associated with monitoring and correcting motor errors during task performance. To examine this issue, data was collected from 42 stroke patients displaying upper-extremity deficits as they completed experimental tasks designed to assess distal force production, sensorimotor memory, and sensorimotor integration abilities. Performance on each of these tasks was compared to 50 healthy, age-matched control participants to determine those with performance outside of the normal range. As expected, a significantly increased proportion of those with performance metrics outside of the range of control participants reported fatigue compared to those with performance within the normal range of age-matched control participants. These data provide an initial examination of the link between skilled-motor performance deficits and the development of post-stroke fatigue, and lay the foundation for future work examining the relationship between increases in mental workload due to errors in predictive motor control and development of this debilitating condition.

MHC 207 1:15 – 1:35

The science of sweet: The effect of artificial sweetener on neurological and behavioral responses in a delay discounting task

Kelene Fercho, University of South Dakota

Artificially sweetened beverage consumption has been associated with negative effects on physical and biological mechanisms, such as body weight, type 2 diabetes, resting metabolic rate, and gut microbial environment; however, less is known about the behavioral effects of dietary history and ingestion of artificial sweetener. To address this gap, this study examined the effects of artificial sweetener consumption on impulsive decision-making and associated neural activity by utilizing a delay-discounting task during functional magnetic resonance imaging (fMRI). When people prefer a smaller-and-sooner (SS) reward to a larger-and-later (LL) reward, they discount the future, a process termed delay discounting; steep and excessive delay discounting has been associated with risky behaviors and adverse clinical conditions. Thirty-two (age range 18-34) right-hand dominant individuals participated in this study. Participants either had significant experience with diet drinks (minimum 2-3/day for at least a year; n = 16) or had no experience with diet drinks (zero diet drinks consumed in the past year; n = 16). Participants completed a delay discounting task during a baseline scan and then again following ingestion of either an orange drink with artificial sweetener or an orange drink with glucose powder which was matched for sweetness and mouth-feel. Delay discounting questions included a choice between a smaller, immediate monetary reward and a larger reward to be received in the future. Participants also completed a questionnaire in which they decided how to spend and save a financial windfall gain. Results indicated that diet drinkers were more impulsive than non-diet drinkers, as indicated by a significantly higher delay discounting rate, as well as a greater intention of spending rather than saving an unexpected windfall. This difference in discounting remained after drink (glucose or artificial sweetener) ingestion. The diet drinker effect remained after controlling for body fat, since the diet drinkers on average had a higher body fat than non-diet drinkers. Linear regression analysis showed that the delay-discounting rate increased with the amount of diet sodas consumed each day. The fMRI analysis showed increased activity within a number of regions within the brain, including regions known to be involved in impulsivity in the diet drink group. Ingestion of glucose reduced activity associated with making difficult intertemporal choices, suggesting that glucose eases the process of making intertemporal choice. These preliminary results suggest that habitual use of artificial sweeteners, such as through diet soda consumption, may be related to decreases in self-regulation and increased activity within brain regions associated with impulsivity.

MHC 207 1:45 – 2:05

Neurovascular signaling mechanisms of erythropoietin

Neeraj Tiwari, University of South Dakota

Multifunctional trophic factors that act on both neurons and vasculature have been shown to produce antidepressant effects. Erythropoietin (EPO), is one such trophic factor. EPO is best known and well-studied for its role in erythropoiesis and is a widely prescribed drug to treat anemia. It is also being clinically tested for the treatment of neuropsychiatric illnesses due to its neurotrophic and neuroprotective effects. A major limitation of EPO in the context of clinical use for CNS diseases is that long-term or high dose administration stimulates excessive red blood cell production and increased blood viscosity. A chemically engineered modification of EPO, carbamoylated erythropoietin (CEPO), does not stimulate erythropoiesis but has similar neurotrophic effects as EPO. The aim of this project is to investigate the molecular mechanisms involved in EPO and CEPOs behavioral effects. In our study of EPO and CEPO, we found that both can induce the expression of genes responsible for neurogenesis and memory formation. This result is in line with the EPO clinical trial studies where they found an increase in hippocampal volume and increase in cognitive abilities in depressed patients. In our, EPO treated endothelial cell study, we found an increase in the expression of genes related to anti-inflammatory and angiogenesis signaling. The gene expression profile in endothelial cells suggests that EPO can protect cellular damage in the brain from pro-inflammatory molecules and maintain normal functioning of the brain via proper blood supply. This study with EPO and CEPO not only provides novel mechanisms for treating psychiatric illnesses but also new therapeutic targets.

Poster 1

Optimized Protocol for Neuronal Differentiation of Induced Pluripotent Stem Cells

Kenneth David, Loraine Campanati, and Kristin Baldwin
Scripps Research, Concordia College

Induced pluripotent stem cells (iPSCs) are derived from mature cells that have been reprogrammed to an embryonic-like state with an ability to differentiate into any type of tissue, making iPSCs potentially transformative for disease modelling and regenerative medicine. However, low differentiation efficacy (DE) remains a critical hurdle for employing iPSCs in experimental and therapeutic applications. With the goal of increasing DE, we adapted an existing reprogramming protocol for neuronal transdifferentiation of fibroblasts and analyzed multiple factors thought to affect DE, including doxycycline concentration (used to turn on gene expression), plated cell density, and supplementation with fibroblast growth factor (FGF). We found an optimal doxycycline concentration for cell viability, and FGF appeared to decrease DE. Interestingly, high density iPSCs produced few neurons, potentially due to cellular crowding. On-going experiments are testing low density cell seeding to increase DE. Once a refined protocol is established, it will be used to explore genetic and epigenetic factors of Autism Spectrum Disorders (ASD) by comparing neuronal gene expression of individuals with ASD to familial baselines.

Faculty Mentor: Kristin Baldwin

Poster 2

Medial prefrontal cortex inhibition attenuates symptoms of depression in Long Evans rats

S. Ackerman, L. Landaeta, A. Miller, B. Podgorsek, A. Willard, and M. Baumgardner
University of Wisconsin-River Falls

Self-focus (i.e. the process by which one engages in self-referential processing) is a core issue in the psychopathology of major depression, which affects 350 million people worldwide. Previous studies have used functional neuroimaging to identify that the cortical midline structures, including the medial prefrontal cortex (mPFC), play a key role in self-referential processing in depressed subjects. The current study investigates the hypothesized link between the mPFC and depression using an animal model of learned helplessness to measure self-referential processing. It is hypothesized that a decrease in symptoms of depression will be seen in animals that have undergone inhibition of the mPFC. This research holds significance in that it builds on previous studies, with conflicting results, that have aimed to link specific patterns of activity to the PFC as mediating symptoms of depression. Further examination of the mPFC is therefore warranted not only as a possible precursor to the implication of its involvement in mediating depression, but also in order to provide support for a theory of dominant pattern of brain activity (inhibition) which interacts with symptoms of depression. The current study utilized female Long Evans rats in order to more accurately generalize findings to the population of women, which make up the majority of depressed individuals in humans. Subjects were exposed to 28 days of randomized stressors during adulthood including forced swim, cage tilt, wet bedding, mild restraint and restriction of food and water. Control animals were housed in pairs, while animals exposed to randomized stress were housed in isolation. Following surgical placement of guide cannula animals were either infused with an inhibitory cocktail (0.3 nmol/0.5µl/side baclofen/0.3 nmol/0.5µl/side muscimol) or sham (artificial cerebrospinal fluid) before being tested for resiliency against learned helplessness. Subjects were tested for latency in a forced swim test and hot plate test, for motivation in a radial arm maze, for lethargy in an open field test, and for anhedonia using sugar pellets. To date, attenuation of learned helplessness symptoms have been found in stress-exposed animals which had undergone inhibition of the mPFC (having also had their self-referential processes inhibited) compared to controls. Collectively, these findings hold significance in that they build on recent research that has aimed to link areas of the PFC to symptoms of depression.

Faculty Mentor: James Cortright

Poster 3

Effects of diazepam on hippocampal neurophysiology and deliberative behavior in predator-inhabited arena

Matthew Erickson, Cody J. Walters and A. David Redish
University of Minnesota; St Olaf College

Anxiety involves consideration of risky, potentially dangerous future outcomes. Previous data from the Redish lab has found that diazepam, an anxiolytic, increases choice-point hesitation and risk-taking behavior on an anxiogenic task, the predator-inhabited foraging arena. In this task, a rat is trained to find food at alternating ends of a linear track, one side of which contains a protected nest space, and then a robot predator is introduced. Rats show fear-related fleeing from the robot and anxiety-like hesitation behaviors at the exit to the nest space. Because the underlying neurophysiological mechanism by which diazepam exerts its anxiolytic effect remains unclear, we investigated anxiety and decision-making on this task with in vivo electrophysiology. Specifically, we implanted probes into the hippocampal layer of 4 rats and recorded while they were in the predator-inhabited foraging arena on either diazepam or its control, Tween-20. We found that these rats' risk-taking behaviors matched those of previous lab data using this task. Additionally, we found that there was a reduction in high frequency sharp-wave activity while the rats were on diazepam relative to its control, Tween-20. It is known that sharp wave ripples, transient high frequency oscillations seen in the hippocampus, play a key role in memory consolidation and reactivation. Diazepam might be reducing anxiety by disrupting hippocampal sharp-wave ripples and, as a result, memory retrieval.

Faculty Mentor: David Redish

Poster 4

Effects of perspective on subjective and physiological responses to narratives involving physical and emotional pain

Amanda Corona, Kristina Humphreys, DaeNia La Rodé, Heidi Storl, and Ian Harrington
Augustana College

Perspective taking requires an ability to infer the mental states of others, underlies important aspects of social interaction, and is thought to involve neural networks including the temporal parietal junction. In this study we were interested in how participants would respond to narratives involving physical and emotional pain written in the second- (i.e., about them) or third- (i.e., about others) person perspective. We also wanted to know how participants' levels of dispositional empathy related to their subjective ratings of discomfort and physiological arousal in response to the narratives. Each participant listened to eight narratives presented via headphones representing one of each combination of painful/non-painful, emotional/physical, and second-person/third-person. Skin conductance was measured continuously and participants provided subjective ratings of discomfort using a 7-point scale after each story. Emotional empathy was measured with the Multi-dimensional Emotional Empathy Scale (MDEES, Caruso & Mayer, 1998). Restricting analyses to the painful narratives, there was a significant interaction of story type (emotional/physical) and perspective (second-person/third-person) on subjective ratings of comfort. Second-person emotional pain was rated similarly to second- and third-person physical pain, whereas third-person emotional pain was rated as more comfortable. In short, participants seemed to discount the emotional pain of others and elevate their own emotional pain to the status of physical pain. We then used the subscales of the MDEES to predict subjective and physiological responses to stories using multiple regression. Several subscales, including positive sharing and suffering, were able to predict subjective responses to physical but not emotional pain, and the subscales emotional attention and feeling for others were able to predict physiological arousal in response to third-person emotional and physical pain, respectively. These findings indicate that perspective taking can be manipulated with simple narratives and that individual differences in emotional empathy can have consequences for how people respond to reports of the pain of others.
Faculty Mentor: Ian Harrington

Poster 5

Female rats show a conditioned object preference for a low dose of morphine after a single conditioning session

Cheyenne Joshua, Yoojin Kim, Alex Mackiel, and Sarah Meerts
Carleton College

A previous study has shown that a conditioned object preference (COP) for mating is established in female rats after one conditioning session. The aim of our study was to test the hypothesis that female rats develop a COP for a low dose of morphine after a single conditioning session. In the COP paradigm, a baseline test is used to assess initial preference for two different objects: an orange-scented plastic duck and an almond-scented plastic bone. During non-reinforced conditioning sessions, two copies of the preferred object are paired with saline and during reinforced sessions two copies of the nonpreferred object are paired with 1 mg/kg morphine. Whether rats show a COP is determined during a post-test by measuring whether the percentage of time spent with the initially nonpreferred object had significantly increased relative to baseline. We conducted two experiments differing in the apparatus design. In Experiment 1, rats underwent one conditioning session in a single chambered, Plexiglas, rectangular box (50 cm x 37.5 x 32 cm). During the baseline and test, the duck was placed in the left corner and the bone was placed in the right corner. Rats did not show a significant COP, which we inferred was caused by deficient dose, apparatus design or the number of conditioning sessions. We increased the number of conditioning sessions to three for Experiment 1B, which still did not yield a COP for morphine. Therefore, in Experiment 2, we changed the apparatus to a three-chambered apparatus (37.5 cm × 37.5 × 32 cm) because previous studies had established a COP with this design but we kept the dose of morphine consistent. In Experiment 2, the percentage of time the rats spent with the nonpreferred object had increased in the post test, relative to the baseline test. These results indicate that morphine is rewarding at a low dose with one conditioning session, but also indicate that a COP could be established using the three chamber apparatus but not the rectangular design. The three chamber apparatus can be used in future studies exploring whether sexually experienced female rats require a lower dose of morphine to develop a COP than naive rats.

Faculty Mentor: Sarah Meerts

Poster 6

Cannabigerol treatment increases social and environmental anxiety

Elizabeth Medina and Kendra Olson
Winona State University

Cannabigerol is one of the major phytocannabinoids that is present in high enough concentrations to contribute to the anxiolytic effects of medicinal cannabis. Cannabigerol increases serotonin levels by blocking the serotonin reuptake transporter (Cascio et. al, 2010) similar to second generation anxiolytics. Thus, cannabigerol was evaluated in this study to determine its potential to produce relief from anxiety. C57BL/6J mice (8-13 weeks) received an intraperitoneal injection of cannabigerol (40 mg/kg) or vehicle. In the three-chamber sociability test, cannabigerol reduced grooming when compared to controls ($t(18)=1.750$, $p < .05$). Analysis of the total amount of time interacting socially revealed that the cannabigerol treated mice spent significantly less time engaging in social contacts ($t(18)=1.919$, $p < .05$) indicating cannabigerol actually increases social anxiety. In the light-dark test of anxiety, cannabigerol also increased measures of anxiety, including a significant reduction in the amount of time rearing ($t (10)=1.936$, $p < .05$) and a significant reduction in transitions between the dark and light chambers ($t(10)=1.968$, $p < .05$). Contrary to our hypotheses, these data suggest that cannabigerol produces changes in anxiety that are dependent on social and environmental cues.

Faculty Mentor: Richard Deyo

Poster 7

Visualizing dopamine dynamics in reward-seeking circuitry

Sowmya Narayan, Marc Pisansky, and Patrick Rothwell
University of Minnesota

Visualizing neuron activity provides a great amount of insight on how the brain functions. Dopamine is the primary neurotransmitter in neural pathways responsible for reward-seeking, and there is much interest in measuring dopamine activity during these types of behaviors so as to solidify our understanding of illnesses like addiction that stem from disorders in these pathways. Recently-developed dopamine indicator molecule dLight1 has been used to image transient dopamine activity with advanced accuracy. We have further demonstrated the utility of dLight1 in measuring dopamine dynamics by recording dopaminergic activity in mice during pharmacological manipulation and both social and intrinsic reward-seeking behaviors. As expected, we found prolonged dopamine presence when mice were injected with amphetamine. Additionally, we found an increase in extracellular dopamine during social rewards. In the future, we can utilise dLight1 in examining dopamine activity during periods of impulsive behavior, so that we can apply this knowledge toward creating better treatments for and curing addiction.

Faculty Mentor: Marc Pisansky

Poster 8

Sexually experienced, but not naive, female rats show a Conditioned Object Preference (COP) after a single training trial.

Tonya Piergies, Jacob Schwartz, Maurice Hicks, Sarah Meerts
Carleton College

During a mating encounter, female rats control the receipt of sexual stimulations through paced mating behavior, approaching and retreating from the male rat. Paced mating behavior of sexually experienced female rats differs sexually naive female rats, which spend less time with the male rat, exhibit longer contact-return latency to intromission, exit more often following intromissions, and display less proceptive behaviors in the male rat's compartment during the first mating experience. Whether the first mating experience is rewarding for sexually naive rats is unknown. Mating-induced reward has only been assessed in sexually experienced female rats; conditioned preference experiments typically involve 3-5 mating sessions so experimental rats are sexually experienced by the time of the post-conditioning test. Given the differences in paced mating behavior between sexually naive and sexually experienced rats, we hypothesized that the rewarding effects of mating differ as well. We elected to use a single trial conditioned object preference (COP) paradigm to test whether mating-induced reward can be observed in rats mating for the first time and rats mating for the fifth time. A baseline test was used to determine preference for one of two objects. During training, experienced and naive rats were tested with one object in the chamber for 10 minutes of mating (uncontrolled number of stimulations) or to 15 intromissions (uncontrolled mating duration). On another day rats were exposed to the other object with no associated mating. A control group received exposure to both objects but never mated. After training the rats were again tested for object preference. As anticipated, sexually naive rats versus sexually experienced rats spent less time with the male rat, exhibited a longer contact-return latency following intromission, received fewer intromissions, and displayed fewer proceptive behaviors with the male during paced mating. Sexually experienced, but not sexually naive, rats developed a COP for mating, in agreement with the idea that mating is differentially rewarding based on sexual history. Future research is needed to determine whether peripheral and/or central sensitization underlies the COP for mating in sexually experienced but not naive female rats.
Faculty Mentor: Sarah Meerts

Poster 9

Role for upregulated REDD1 and disrupted mTORC1 in the prelimbic-nucleus accumbens pathway in depression related deficits in motivated behavior

Bethany Windsor, Erik Van Newenhizen, Mitchell Spring, Nicholas Raddatz, Sara Kassel, Evan Hess, Robert Wheeler, and John Mantsch
Marquette University

A hallmark characteristic of patients with major depressive disorder is a deficit in motivated behavior. Our goal is to characterize a pathway underlying these changes in motivated behavior, using a chronic variable stress model (CVS) where every day for 14 days, male sprague-dawley rats are subjected to a random stressor from a battery of stressors twice daily. Post-mortem assessment confirmed increased activation of the HPA axis, as indicated by adrenal hypertrophy and thymus atrophy when CVS rats were compared to control, non-stressed rodents. Changes in motivated behavior were examined using a Pavlovian autoshaping approach where the presentation of a CS+ or CS- lever predicted the delivery of a sucrose pellet or no reward delivery, respectively. Both CVS and non-CVS animals rapidly acquired a learned interaction with the CS+ lever. However, CVS experience delayed acquisition and produced reduced approach even after acquisition, suggesting that there has been a significant change in pathways involved in cue-reward signaling. The changes observed in the autoshaping task have led us to begin characterizing changes in the prelimbic prefrontal cortex to nucleus accumbens pathway, as this pathway has been historically viewed as a key pathway in goal-directed behavior, and literature suggests that there is significant regressive neuroplasticity occurring in the PL during times of stress as a result of alterations in the mTORC1 signaling cascade (Ota et al. 2014. Nature Medicine, 20(5), 531-535. http://doi.org/10.1038/nm.3513). The mTORC1 signaling cascade is critical for synaptic upkeep and remodeling. Our western blot analyses demonstrate that in the synaptoneurosome of the prelimbic cortex, there is a significant upregulation of the mTORC1 inhibitor, REDD1, confirming observations found previously (Ota et al. 2014). REDD1 upregulation, and the subsequent decrease in mTORC1 activity as measured by a decrease in the ratio of phosphorylated to total raptor, may drive the changes in motivated behavior previously observed. Future analysis of the pathway from the prelimbic prefrontal cortex to nucleus accumbens will be observed using a fluorescent tracing approach combined with fluorescence activated cell sorting and quantitative polymerase chain reaction to measure changes in a pathway-specific manner. Using viral-mediated approaches, we will alter the mTORC1 signaling cascade specifically in the prelimbic prefrontal cortex to nucleus accumbens pathway and observe changes in motivated behavior, testing for sufficiency and necessity of various proteins in the mTORC1 signaling cascade. By understanding the pathways underlying characteristics of depression, we hope to guide the development of targeted therapies for depressed individuals.
Faculty Mentor: John Mantsch

Poster 10

Electrophysiology of error processing: Does the error positivity have a mirror image negativity?

Katie L. Beard, Samuel J. Becker, Sierra D. Dortch, Denee J. Reimer, Sean W. Dubiel, Emily E. Hite, Maggie Westerland, and Madison D. Moeller
University of Wisconsin- Eau Claire

The Pe (error positivity) is a positive deflection in the electroencephalography (EEG) peaking around 250ms following a response when a person makes an error, especially if they are aware of having made the error. In two studies of error processing, participants completed a flanker task to invoke error responses within the EEG signal. The distribution of event-related potential (ERP) components across the scalp suggests that the neural activity that appears as a Pe at posterior electrode sites may also show up as a negativity at anterior sites. This pattern of inversion has not been widely shown in other studies using similar tasks, however literature review and consultation with other EEG researchers has pointed to Pe inversion at frontal sites as a possible phenomenon, based on the spatial orientation of the Pe's neural generators and/or how data are referenced. We examined correlations between signal amplitudes of the Pe at posterior sites and amplitudes at frontal sites but the implications of the correlations observed are not clear. We are currently exploring independent components analysis as a means of investigating whether the observed Pe inversion at frontal sites is representative of the same neural generators as the classic Pe or a distinct set of generators.

Faculty Mentor: David Leland

Poster 11

Preoccupation with food and body image increases beta wave frequency

Shayde A. McKay
Winona State University

We evaluated the extent to which cortical and limbic structures are involved in the negative food and body image preoccupations associated with eating disorders. Twenty-nine undergraduate students completed the Yale-Brown-Cornell Eating Disorder Scale (YBC-EDS) to measure preoccupations with food and body image. Participants' YBC-EDS scores were used to group individuals into a food/body image preoccupation group or normal group. Participants then viewed 36 food and body images while completing an electroencephalogram (EEG). EEGs were correlated with the normative valence (pleasant to unpleasant) and arousal (calm to excited) levels for each image, and with participants' YBC-EDS score. We hypothesized that participants with food and body image preoccupations would present increased beta wave frequencies in response to image presentation. A significant interaction between the time of recording and the preoccupation group was found $F(4, 104) = 2.48$, $p < .05$. Analysis of the interaction revealed that the preoccupation group ($M = 4.81\%$, $SD = 34.78$) presented significantly higher changes in beta wave frequencies two seconds after image presentation compared to the normal group ($M = -21.07\%$, $SD = 37.65$), $t(26) = -1.79$, $p < .05$. These results show that individuals with food preoccupations have abnormal beta waves.

Faculty Mentor: Richard Deyo

Poster 12

Sensory modality and autistic traits influence Theory of Mind

Elaina M. Smith
Winona State University

A measure was developed to quantify Theory of Mind [TOM] employment; participants watched movie clips and then answered multiple-choice questions about the feelings, mental activities, and future behavior of the actors in the clips. TOM scores were compared with scores from the shortened version of the Autism Quotient [AQ-S], which measures the degree of autistic traits in adults. In a pilot study, 13 of 42 participants met the AQ-S cutoff that distinguishes autistic individuals from controls. These participants scored significantly lower on TOM employment. Overall, TOM scores were negatively correlated with AQ-S scores. In the next experiment, auditory and visual processing were compared to analyze modality differences in employing TOM. Clips were presented in either their original format, or as just the audio or video portion. As auditory information contains both linguistic and paralinguistic cues, it was hypothesized that TOM scores across all participants would be higher from the audio-only clips than from the video-only clips. Differences in TOM employment were also expected between those who were above and below the AQ-S cutoff, with those possessing a higher number of autistic traits scoring lower on TOM employment. Additionally, different cognitive components of TOM were analyzed.

Faculty Mentor: Richard Deyo

Poster 13

Crush injury: An unrecognized impact

Daniel Rafter, Margaret Y. Mahan, Tabitha Chettupally, Kriti Prasad, and Uzma Samadani
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Conventionally, traumatic brain injuries (TBIs) have been associated with a clear trauma to the head. However, patients with elevated intrathoracic (ITP) and intraabdominal pressures (IAP) as a result of crush injuries may potentially also suffer TBI due to elevated intracranial pressure (ICP). These neurological implications are poorly understood and more often than not undiagnosed. We prospectively recruited 625 trauma subjects and healthy non-trauma controls in whom we performed eye tracking and analyzed serum samples for neurological blood based biomarkers to characterize and classify the nature of their brain injury, if any. Eight subjects were identified that had sustained crush injuries and were then subcategorized as isolated thoracoabdominal, thoracoabdominal with blunt head trauma, isolated extremity, and extremity with blunt head trauma. The eye tracking metrics and biomarker concentrations were then compared to both healthy non-trauma control and known TBI subjects. Our preliminary findings suggest that thoracoabdominal crush can lead to elevated ICP resulting in eye tracking and serum biomarker findings consistent with brain injury. Future work may elicit the intra-abdominal pressure and intrathoracic pressure elevation necessary to increase the ICP and produce these demonstrated ocular motility dysfunctions as well as explore the impact of other crush injuries on ICP.

Faculty Mentor: Daniel Rafter

Poster 14

Antihistamines modulate the inflammatory activity of cultured microglia

Mallory Mefferd and Paul D Storer
Coe College

Multiple sclerosis (MS) is a neuroimmunological disorder, distinguished by the loss of myelin-producing oligodendrocytes and axonal damage in the central nervous system. Microglia are of key interest in the pathogenesis of MS. Notably, microglia are understood to respond to histamine, a biogenic amine that modulates the innate immune response via the H1 receptor. Through treating microglia with HR-1 antagonists (antihistamines), we were able to examine the potential role that these factors have on the microglial immune response. In this study, clemastine, a first generation antihistamine, was used to treat cultured N9 microglial cells, the hypothesis of the study being that this would cause a down-regulation of proinflammatory factors (e.g. Interleukin-1beta, TNF-alpha), nitric oxide synthetase (iNOS), and modulate the translocation of NF-κB. Additionally, we hypothesized that clemastine would upregulate important growth factors (e.g., BDNF and CNTF) from these microglia. With the use of endpoint PCR, nitrite assays, real-time PCR, immunocytochemistry, and ELISA, we were able to demonstrate a down-regulation in pro-inflammatory factors and an up-regulation in growth factors from clemastine-treated microglia in association with activation by LPS. Therefore, this study supports the understanding that antihistamines have immunoregulatory functions, and suggests that antihistamines can aid in the up-regulation of growth factors, which could lead to neuronal repair in conditions of MS and other similar CNS pathologies.

Faculty Mentor: Paul Storer

Poster 15

Estrogen modulates glutamate uptake by cultured astrocytes

Megan Houle and Paul D Storer
Coe College

During brain injury, the neurotransmitter glutamate can be released in toxic levels by resident cells. Astrocytes, glial cells which maintain a stable extracellular environment, remove excess glutamate from the surrounding environment via the glutamate transporters GLT-1 and GLAST. Furthermore, the enzyme glutamine synthetase (GS) in these astrocytes converts cleared glutamate into the non-toxic metabolite glutamine. There is evidence that estrogen plays a neuroprotective role in the brain, perhaps by enhancing this glutamate uptake process. This study used the C6 astrocyte cell line to explore the ability of beta-estradiol to increase the expression of glutamate transporters and consequently the clearance of glutamate from the cellular environment. After treating with 100nM β-estradiol, qPCR was utilized to quantify the difference in expression of GLT-1, GLAST, and GS genes. Glutamate uptake was also measured using a colorimetric assay. Astrocytes treated with estrogen were found to have increased expression of GLAST and GS relative to control. Additionally, estrogen treatment caused an increase of glutamate clearance from the extracellular environment compared to control. These results support the role of estrogen as a neuroprotective factor via its positive influence on glutamate uptake in the CNS in conditions of trauma or similar pathologies.

Faculty Mentor: Paul Storer

Poster 16

PI3K subunits in the rat supraoptic nucleus

Victoria Ihry, Emily Weidner, Austin Grove, and Munir Isahak
Concordia College

We demonstrated previously that the hypothalamic supraoptic nucleus (SON) undergoes a robust axonal sprouting response following unilateral transection of the hypothalamo-neurohypophysial tract in a young, 35-day-old rat. However, no collateral sprouting occurs following axotomy in a 125-day-old rat. Our lab has in vitro evidence demonstrating the role of CNTF (ciliary neurotrophic factor) in promoting process outgrowth via PI3K signaling. Thus, we compared the protein levels of the PI3K catalytic and regulatory subunits in the SON between 35- and 125-day rats. We found less protein of the catalytic domain, PI3K p110gamma, in the 125-day rat SON; however, we did not observe changes in the other three catalytic domains nor the regulatory domains that we analyzed. Dual fluorescent studies demonstrated that all PI3K catalytic and regulatory subunits analyzed are localized to astrocytes and neurons in the SON. These data suggest that the lack of PI3K p110gamma found in the 125-day rat SON may prevent the collateral sprouting response from occurring, but future studies need to be performed to confirm this hypothesis.

Faculty Mentor: Jason Askvig

Poster 17

A systematic review of genetic risk factors for traumatic brain injury

Mohit Uppal, Duncan Hurrelbrink, Timothy Suek, Aliya Ahmadi, Radhika Edpuganti, Daniel J. Rafter, and Uzma Samadani
Hennepin Healthcare, University of Minnesota

Traumatic Brain Injuries (TBI) are the primary cause of a substantial amount of all injury-related deaths. Diagnostic ability of TBI has remarkably increased during the 21st century with a large increase of emergency department (ED) diagnoses for mild TBI (concussion). As this rate increases, the need for an objective predictor of TBI and risk following TBI is needed. This review is aimed to identify and categorize genetic determinants of TBI based on pre-injury impulsivity, aggression, and ADHD-like symptoms risk, short term edema and non-edema risk, and predisposition to obtaining long term symptoms associated with TBI. 29 genes were identified: 7 determining pre-injury risk, 6 determining symptoms associated with short-term edema, 5 determining symptoms associated with short-term non-edema, and 11 determining predisposition to long-term symptoms. While investigations of genetic impact and influence on traumatic brain injury are still developing, using such genetic indicators has the potential to aid the diagnostic and prognostic processes involved.

Faculty Mentor: Uzma Samadani

Poster 18

Crawling back to you: A study of leeches and light

Emiliya Bayko, Elizabeth Beseka Nammeh, Andrew Clayburn, Brandon Young, and Cynthia Harley
Metropolitan State University

We have been examining the influence of physical therapy on the recovery of leeches with nerve cord injuries. When a leech has its nerve cord severed, it loses the ability to crawl. This ability returns over time without regrowth of the nerve cord. One of our hypotheses is that the sensory system fills in the gap left by the injury. To test this hypothesis, we have developed a physical therapy method which stimulates a leech's sensory system. However, this has left us with a stumbling block—we need to separate the willingness of leeches to move from their ability to move. To do that we have used a variety of stimuli to determine which is the best stimulus to evoke movement in healthy leeches. In the future, we hope to apply this methodology to our transected leeches to assess recovery.

Faculty Mentor: Cynthia Harley

Poster 19

Deficits of musical pitch perception in cases of developmental prosopagnosia

Rachel Nordberg, Keaton Shinn, Kelly Whiteford, Andrew Oxenham, Jason Barton, and Sherryse Corrow
Bethel University

Developmental prosopagnosia is a visual cognitive disorder affecting one's ability to recognize familiar faces. Individuals with prosopagnosia find themselves unable to recognize faces of their friends, family members, and even themselves (Corrow et al., 2016). The exact cause of prosopagnosia is unknown, however, it affects approximately 2% of the population. One hypothesis is that prosopagnosia is the result of a cortical migration disorder of the right hemisphere. If this is the case, other right-hemisphere dominant functions should be affected. In the current study, we asked whether those with prosopagnosia were more likely than the general population to have a amusia, a right hemisphere developmental disorder that affects one's fine pitch discrimination (tone deafness). By asking whether these two disorders occur in a higher rate within the same population, we hope to understand whether prosopagnosia is an isolated disorder or part of a larger syndrome.

Faculty Mentor: Sherryse Corrow

Poster 20

Combined pro-regenerative strategies and targeted rehabilitation to improve behavioral outcomes after spinal cord injury

David Nowak, Erik Eastwood, Naveen Jayaprakash, and Murray Blackmore
Marquette University

Regeneration of injured axons following spinal cord injury is critical to restore lost motor function. A low cell-intrinsic capacity for regeneration and hostile extrinsic factors at the injury site both act to limit axon regeneration. To overcome these twin barriers, we have combined overexpression of a pro-regenerative transcription factor called KLF6 in injured neurons with grafts of stem cells into spinal injuries. This combined treatment enables corticospinal tract (CST) regeneration through sites of spinal injury. Furthermore, combined optogenetics and electrophysiology showed that the regenerating axons form functional synaptic connections with host neurons below the injury. Despite the growth and synaptogenesis, however, behavioral gains were minimal. Here we test the hypothesis that elevating neural activity, in the context of stimulated CST regeneration, will improve behavioral outcomes after spinal injury. To do so we have developed a system of combined electrical stimulation, limb constraint, and post-injury rehabilitation in the form of forced irregular wheel running. In initial experiments, adult mice received midline cervical (C4-C5) 1mm deep wire-knife transections followed by casting of the uninjured limb for 4 weeks. Animals were then exposed daily to forced locomotion on a wheel with irregularly spaced rungs every day for 8 weeks. The combined casting and rehabilitation significantly improved forelimb function on the horizontal ladder task. In our ongoing experiments this behavioral activity is supplemented by sub-threshold, extra-dural electrical stimulation of the motor cortex. By combining pro-regenerative treatments with optimized rehabilitative paradigms, we aim to improve behavioral outcomes after spinal injury.
Faculty Mentor: Murray Blackmore

Poster 21

Characterizing the pathological role of tau in alpha synuclein-dependent synaptic and memory deficits in vivo

Emmanuel Okematti, Balvindar Singh, and Michael K. Lee
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Parkinson's disease (PD) is a chronic, progressive neurodegenerative disorder characterized by motor impairment due to the degeneration of dopaminergic neurons in the substantia nigra pars compacta. Prior research demonstrates mutations in the α-synuclein (αS) gene cause familial autosomal dominant PD, with αS aggregates being linked to neuronal dysfunction and ultimately, cell death. Furthermore, the non-motor symptoms of PD, such as cognitive impairment, hinder patient quality of life and are not addressed by current therapies for treating PD. Tau, a microtubule-stabilizing protein, has been implicated in driving neuronal dysfunction and memory deficits in models of other neurodegenerative diseases such as Frontotemporal dementia and Alzheimer's Disease (AD). In these conditions, tau is found mislocalized from axons to neuronal cell bodies and dendrites, a feature associated with synaptic dysfunction and behavioral deficits. Herein, we investigate the mechanisms by which mutant, disease-causing αS contributes to tau mislocalization and dementia in a mouse model of PD. Specifically, we demonstrate that specific αS-induced changes in this mouse model, cognitive impairment, are due to the mislocalization of tau to the cell bodies of hippocampal and cortical neurons. This ultimately provides a novel mechanism for by which mutant αS can drive non-motor symptoms in PD.

Faculty Mentor: Michael Lee

Poster 22

Contrasting the loss of neural cells with the accumulation of beta amyloid plaques in cotton top tamarins: Aging or degenerative disease?

Christopher Kwon, Colin Liphart, Gifty Amos Nwankwo, Max Pope, and Chris Leppink-Shands
Carleton College

We examine the rate of loss of cells in young adult and aged monkeys post mortem and contrast that with the gains seen in accumulating beta amyloid plaques across the same ages. We also present some evidence of astrocyte increase with age. The combination suggests that we are studying a natural aging process generally, but that some monkeys appear to have an Alzheimer's like reaction in that they have exponentially more plaques and more astrocytes which may be reactive. The data anlyses begin to identify ways to separate aging processes from disease processes in monkeys.

Faculty Mentor: Julie Neiworth

Poster 23

Effect of human wild type alpha-synuclein overexpression on dendritic spines in mouse cortex

Georgina Aldridge, Lucia Wagner, Sheyna Nathwani, Cole LaLonde, Qiang Zhang, and Nandakumar Narayanan
St. Olaf College; University of Iowa

Patients with Lewy body dementias, an umbrella term that includes Parkinson's disease dementia (PDD) and dementia with Lewy bodies (DLB), are characterized by an atypical deposition of synuclein aggregates in the cerebral cortex. Synuclein overexpression in patients with genetic abnormalities is linked to these respective neurodegenerative diseases. It is currently unknown whether the synuclein protein directly or indirectly affects the cortical neurons, including prefrontal cortex, one site hypothesized to be affected in these diseases. In this study, we used viral overexpression of human, wild type alpha-synuclein to investigate whether alpha-synuclein overexpression in the prefrontal cortex alters the morphology of dendritic spines, the postsynaptic connections that facilitate communication between neurons. Anomalies in dendritic spine structure are seen in diverse forms of dementia. An AAV-6 viral vector coding for human alpha-synuclein was employed to generate targeted overexpression of this protein bilaterally in the infralimbic and prelimbic regions of prefrontal cortex of adult mice. The brain was stained after three months with either immunohistochemistry or golgi-cox impregnation for dendritic spine anatomy, thus illustrating over-expression of synuclein within the medial prefrontal cortex. Analysis of these dendritic spines exhibited evidence for increased dendritic spine density in apical dendrites from layer five pyramidal cells. In addition, the length of basilar dendritic spines increased with overexpression of the protein. This finding is intriguing, given other models of synuclein aggregation, mutation, or overexpression have causes decreases in dendritic spine density. Our future research will investigate whether the changes are an effect of time, local effect, and/or aggregation status of the protein.

Faculty Mentor: Georgina Aldridge

Poster 24

Rapamycin inhibits inflammatory responses in cultured glial cells: Implications for the development of obesity

Rachel Rethwisch and David Lo
Coe College

Hypothalamic inflammation is a major contributor to the pathogenesis of obesity. Recent studies have identified the nuclear factor kappa B (NF-kB) inflammatory signaling pathway within hypothalamic glial cells, microglial and astrocytes in particular, as a critical mediator of metabolic dysregulation and obesity susceptibility. Rapamycin was previously shown to inhibit NF-kB signal transduction in neurons stimulated with tumor necrosis factor alpha (TNFα), revealing a novel connection between the mammalian target of rapamycin (mTOR) and NF-kB pathways. By investigating the connection between the NF-kB and mTOR pathways in astrocytes and microglia, the current study seeks to better understand the molecular pathways that regulate the control of energy homeostasis under conditions of dietary excess.

Faculty Mentor: David Lo

Poster 25

The role of the astrocytic glutamate transporter 1 (GLT1) in mood disorders

Amanda J Grebinoski, Katheryn M Wininger, Yun Fang Jia, Lee Peyton, Seungwoo Kang, and Doo-Sup Choi
Mayo Clinic and Winona State University

Glutamate is the main excitatory neurotransmitter in the brain which is regulated through its transportation from the synapse into an astrocyte and recycled. Astrocytic glutamate transporter 1 (GLT1) is the main transporter for removing glutamate from the synaptic cleft and into the astrocyte. This process is important for maintaining homeostasis within the brain including regions responsible for mood disorders. We anticipated that a constitutive deletion of GLT1 from astrocytes would result in subjects exhibiting more anxiety and depression-like behaviors due to prolonged glutamate exposure. The cre-flox system was used to generate C57BL/6J mice with a deficiency of GLT1. Subjects with the GLT1 deletion were assessed for anxiety-like behaviors through the use of the elevated plus maze. GLT1 floxed mice spent significantly more time in the open arms than that of their control littermates. Subjects tested on the tail-suspension and forced swim tests also expressed a significant decrease in depression-like behaviors when measuring the immobility time. Therefore, when GLT1 was deleted from the astrocytes, subjects exhibited a decrease in both anxiety and depression-like behaviors. These results suggest that targeting the astrocytic GLT1 may represent a promising new approach in developing treatments for mood disorders.

Faculty Mentor: Doo-Sup Choi

Poster 26

Quantifying cochlear nerve myelination in mice lacking thyroid hormone transporters

Marissa Swenson, Stephanie Peterson, and David S. Sharlin
Minnesota State University, Mankato

Thyroid hormone (TH) is essential for development of many organs and tissues, especially nervous tissue. Without access to TH, the architecture of neuronal tissue develops improperly, leading to functional deficits in neurons (Ahmed, 2007). One disease where this is the case is Allen-Herndon-Dudley Syndrome (AHDS), which is caused by mutations in the MCT8 gene. MCT8 mutations lead to severe psychomotor retardation, with global developmental delays and severe intellectual disabilities (Mayerl et al, 2014). Mice lacking two TH transporters - Mct8 and Oatp1c1 - that facilitate TH uptake and efflux across the cell membrane, model AHDS. Recently, we found that mice lacking both transporters have normal cochlear development, but display delayed auditory signaling. Thus, our experiments aim to test the hypothesis that auditory deficits observed in mice lacking Mct8 and Oatp1c1 is due, in part, to altered myelination of the auditory pathway. Our previous work using FluroMyelin staining revealed decreases in myelin throughout the cochlea in double knockout mice. However, to quantitate myelin changes, we are using qRT-PCR to directly measure myelin associated glycoprotein (MAG) mRNA levels in cochlear and peripheral nervous tissues. Based on our Fluoromyelin observation, we expect to observe decreased MAG mRNA within the cochlea, supporting the idea that delayed auditory processing was the result of reduced myelination. Overall, this research will further define the need for TH transporters in development of normal auditory function. Understanding the mechanism involved in this process may help those who suffer from AHDS, leading to a better quality of life for these individuals and many others who also have auditory deficits due to low TH.

Faculty Mentor: David Sharlin

Poster 27

Zika virus as a immunotherapeutic adjuvant against malignant gliomas

Clairice Pearce , Andrew T. Crane, Maple Shiao, Joseph P. Voth, Christopher Sipe, Shivanshi Vaid, Nikolas Toman, Craig J. Bierle, Mark R. Schleiss, Venkatramana D. Krishna, Maxim C. Cheeran, and Walter C. Low
University of Minnesota

Glioblastoma multiforme is the most aggressive form of brain cancer and has limited treatment options. 5 years after the initial diagnosis, survival rates for patients with grade IV tumors are at 5%. Because Zika virus (ZKV) induces apoptosis in neural stem cells, and similarities between neural and glioma stem cells exist, it has been suggested that ZKV may be a viable therapeutic option for malignant gliomas. We have shown that ZKV in fetal brain tissue increases expression of genes related to immune response, autophagy and apoptosis. Human and murine glioma cell lines express the presence of characteristic ZKV proteins after viral exposure as well as putative receptors for ZKV entry, indicating these receptors may act as a mechanism in ZKV pathology. Plaque-forming assays reveal murine gliomas are relatively resistant to ZKV replication while highly passaged human gliomas are highly permissive to ZKV propagation and virus-induced cell lysis. To interrogate ZKV as an oncolytic agent in vivo, we induced murine GL261 brain tumors in immunocompetent and immunodeficient mice. This was followed by injection of ZKV at the same coordinates. ZKV did not significantly prolong the overall survival of tumor-bearing mice. Because the virus can elicit an immune response within the periphery, we next sought to determine if ZKV could be used in conjunction with immunotherapy. Similar to the oncolytic experiment, we induced brain tumors in immunocompetent and immunodeficient mice. The treatment group was injected with ZKV at the same coordinates used for glioma induction, and on the following 3-, 7-, and 14-days, mice were subcutaneously infused with irradiated GL261 tumor cells previously infected with ZKV. Results show an increase in overall survival of the immunocompetent treated mice, with roughly half of all mice in this group surviving long-term. These long-term survivors were re-challenged with tumor cells, and the immune response was analyzed using flow cytometry. Relative to age-matched tumor-bearing controls, we observed increases in activated microglia and infiltrating T-lymphocytes in the brains of treated tumor-bearing mice. These results suggest that ZKV acts as an adjuvant, signaling an immune response to the infected tumor cells in the brain.

Faculty Mentor: Walter Low

Poster 28

Food cravings after bariatric surgery: Sleeve Gastrectomy versus Roux-en-Y Gastric Bypass

Marie Kasparova, Afton Koball, Kara Kallies, and Luis Ramirez
Winona State University, Gundersen Lutheran Health System

Food cravings are largely associated with weight management difficulties especially in patients with obesity. Unfortunately, little is known about food craving differences in those who have bariatric surgery. The current study aimed to examine change in overall food cravings after bariatric surgery and to compare these changes in Roux-en-Y Gastric Bypass (RYGB) versus Sleeve Gastrectomy (SG) patients. We also evaluated psychological predictors for possible effects on cravings. The Food Craving Inventory II (FCI-II) was given to 92 patients pre-operatively and then again at 3, 6, 9 and 12 months after undergoing either RYGB or SG. In addition, surveys assessing anxiety, depression, emotional overeating, and food addiction were administered. Overall food cravings decreased from pre to post. Individual FCI-II subscales (carbohydrates, sweets, fats, fast-food fats) also decreased. There were no differences in food cravings between RYGB and SG patients except for carbohydrate cravings. Both higher depression and food addiction scores were linked to food cravings at every time point of the study. Additionally, a positive relationship was found between emotional overeating and carbohydrates cravings. Results of this study may be used to guide provider and patient decision making about which bariatric surgery may be the best fit.

Faculty Mentor: Richard Deyo

Poster 29

The effects of synedrella nodiflora (L.) gaertn whole plant extract in ketamine-induced psychosis in mice

Rachel McLeod, Owusu Ansah, and Daniel Freeman
University of Ghana School of Pharmacy, Augustana College

Psychosis is a mental condition in which the individual experiences delusions and hallucinations. Current treatment methods include the use of behavioral therapy and antipsychotic drugs. However adherence to the medications given is a problem especially in patients with chronic cases owing to the extent of the side effects and the perceived ineffectiveness of the mediations. In preliminary experiments the ethanolic extract of the whole plant of Synedrella nodiflora (L.) Gaertn (SNE) was shown to have significant antipsychotic activity. Since this model presents only positive symptoms of psychosis, a model that will provide negative symptoms is warranted. Thus the present study will investigate the effects of the extract in ketamine-induced psychosis in mice, a test model that will present both negative and positive symptoms. The behavioral tests will include assessment of locomotor activity, cognitive functions and social interactions of extract/reference drug pretreated mice with and without ketamine.

Faculty Mentor: Patrick Amoateng

Poster 30

Affordable open-source micro-drive array for chronic in-vivo recording of rodent neural systems

Arjun Ramachandran and Atefeh Alavi
St. Olaf College

Among the many challenges of chronically recording neuronal activity from multiple cells is the cost of purchasing or producing microdrives that fit the functionality and spatial requirements for specific recording demands. These challenges are even greater when employing such technologies in the instruction of undergraduates or during research at under-funded institutions. Here, we have designed and built a customizable microdrive array that allows for individual driving of 8 tetrodes, each consisting of 4 wires twisted together (32 electrodes), with a drive body that is entirely 3D-printable using a standard 3D printer. This is assembled using cheap and easy to source materials. The quick turn-around time and cheap cost of our microdrive allows for basic in-vivo electrophysiology to be feasible for undergraduate or teaching laboratories.

Faculty Mentor: Gary Muir

Poster 31

Steroid hormone induced plasticity in the forebrain region of *Anolis carolinensis*

Mohannad Alhuwaish and Kyle Mercer
Minnesota State-Mankato

Testosterone has distinct effects on seasonal brain morphology and behavior. Our animal of interest, the green anole lizard, Anolis carolinensis, is known for reproductive displays such as extension of the dewlap, a red throat fan, aggressive behavior such as defending territory against other males, and pushups. These behaviors are observed during the breeding season, but not in the non-breeding season. Forebrain areas that are being studied include the preoptic area (POA) which facilitates masculine reproductive behavior under androgen treatment, and the ventromedial hypothalamus (VMH) which facilitates female reproductive behavior. These areas are also known to change volume seasonally, but the specific mechanism is unknown. Our experiment seeks to understand the mechanism by which steroid hormones act on nuclei in the forebrain to induce seasonal differences. Our experiment was conducted on gonadectomized breeding season males. Steroid hormones were then introduced through a long acting implant, supplying testosterone, DHT, estradiol, or vehicle. We expect to see soma size and cell proliferation in steroid hormone treated lizards to be restored to breeding season levels within the POA and the VMH, as has been shown in previous work. Future studies may include measuring the distances between neurons, dendritic branching, or glial cell counts, which may explain changes in brain area volumes. It is likely that steroid hormones are critical for maintenance of breeding season morphology; however, it is also predicted that there may be other factors contributing to soma size and cell proliferation.

Faculty Mentor: Rachel Cohen

Poster 32

Shoaling preferences in zebrafish

Emily Hilfers, Yanick Tade, and Emily Hao
Concordia College

Danio rerio (zebrafish), are small, active freshwater fish employed across many areas of neuroscience research. Readily accessible and relatively easy to maintain in the laboratory, zebrafish share many features with mammalian models, and their curiosity and learning ability make them a useful model in behavioral neuroscience research. Lines of commercially available genetically modified Danio called Glofish® are popular as pets in the United States for their striking fluorescence under UV light, but are a prohibited GMO in some countries. We were interested in comparing environmental preferences and shoaling behavior in wild-type and Glofish® Danio and to determine whether social housing conditions affect their behavior. Wild-type and Glofish® Danio were housed as homogeneous or heterogeneous groups prior to measuring time spent in a variety of environmental and social interaction condition dyads. Data were recorded using the Ethovision behavioral tracking system. We found an effect of social housing arrangement on environmental and social interaction preferences and will share analyses of these differences.

Faculty Mentor: Krys Strand

Poster 33

Identification of brain regions activated with arousal-induced clock resetting in mice

Cera Langton, Sarah Mackowski, and Dawn Paukner
University of Wisconsin-Eau Claire

The purpose of this study was to identify brain regions involved in the regulation of circadian rhythms. Circadian rhythms are important in many aspects of human behavior and can impact patterns of rest and activity. Desynchronization of the circadian clock with the external environment results in various sleep disorders, mood disorders, and other behavioral symptoms. We used mice as a model to study the synchronization of circadian rhythms to the environment. Mice were entrained to a 12:12 LD cycle and then transitioned into complete darkness at CT-6 (circadian time, 6 hours before transition to dark). This transition causes a 2.5-hour advance of their circadian clocks. At CT-7 the brains were extracted and processed for detection of Fos protein, a known neuronal activity marker. Visualization of Fos protein allowed us to quantify levels of neuronal activity in various regions of the brain. Thus far, our team has found significant differences in Fos levels between the experimental and control groups in the retromammillary nucleus, intergeniculate leaflet, lateral septal nucleus and the reticular thalamic nucleus. We are continuing to analyze other regions of interest including the thalamic interlaminar nucleus, anterior cingulate cortex, and the piriform cortex.

Faculty Mentor: Dan Janik

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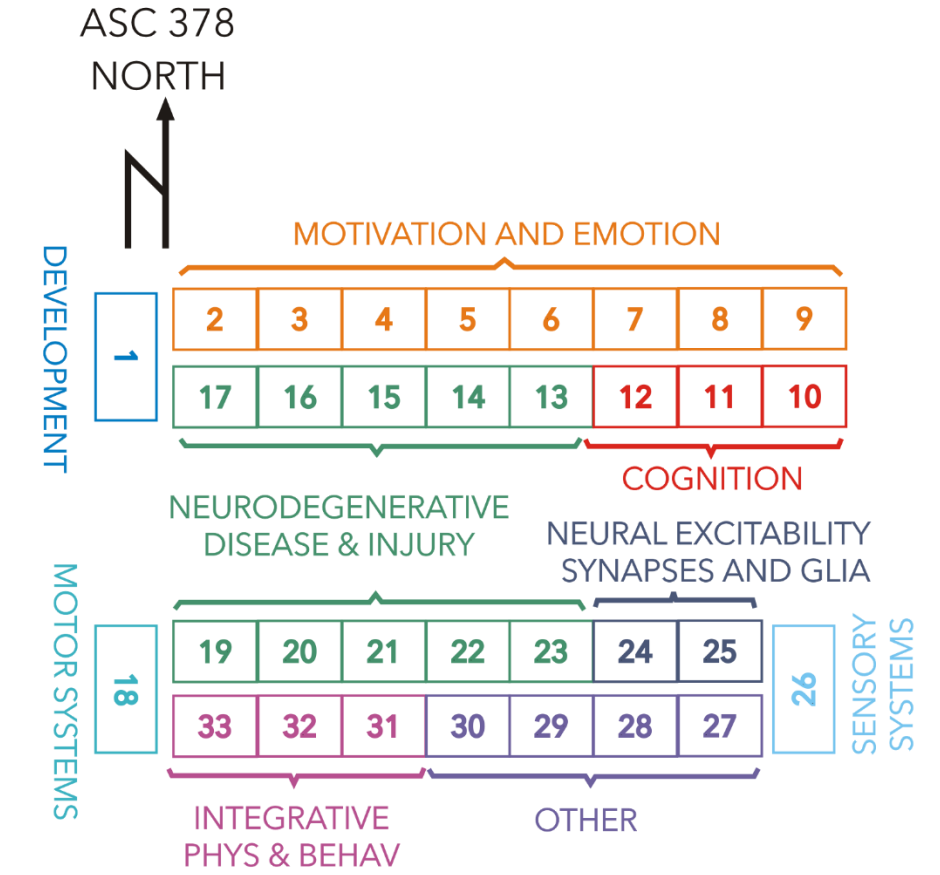

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