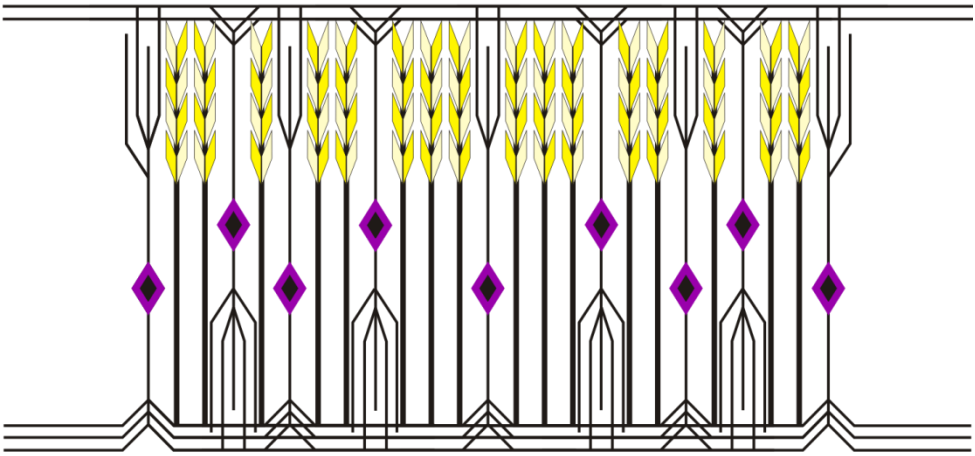
MIDBRAINS



2016

Midwest Regional Undergraduate
Research Symposium in Neuroscience

Final Program and Abstracts

Saturday, November 5

UNIVERSITY OF
St.Thomas

PROGRAM AND SCHEDULE OF EVENTS

8:00 – 9:00 am	Registration Poster Installation	OWS 1st Floor

9:00 – 10:00 am	Keynote Address	OWS 150

Thanks for the memories: How undergraduate research led to a career identifying the molecular mechanisms through which estrogens enhance memory

Karyn Frick, PhD
University of Wisconsin-Milwaukee

10:15 am - Noon Graduate program research talks
OSS 127, OWS 150, OWS 251, OWS 257, OWS 275

12:00 - 1:15 pm	Lunch - Faculty Lunch - Students	ASC 364 & 365 The View (ASC 2nd Floor)
1:15 - 2:15 pm	Graduate School Panel	OWS 150
2:30 - 3:30 pm	Graduate School Info Fair	OWS 166
2:30 – 3:30 pm	Poster session and social	OWS 1st Floor

GRADUATE PROGRAM RESEARCH TALKS

10:15 am

OSS 127 Methamphetamine self-administration and changes in brain neurochemistry. *Lisa McFadden, University of South Dakota*

OWS 150 Motivated behavior in mouse models of autism. *Nicola M. Grissom, University of Minnesota*

OWS 251 L-type calcium channel, CAV1.2, in mitochondria mediated cell death. *Maria Noterman, University of Iowa*

OWS 257 Mechanical forces that guide developing axons. *Bob Nichol, University of Wisconsin*

OWS 275 A double-edged sword: Pro- and anti-nociceptive effects of endocannabinoids. *Brian D. Burrell, University of South Dakota*

11:05 am

OSS 127 Disrupting adolescent prefrontal cortex dopamine increases drug cue seeking in adulthood. *Shaydel Davies, University of South Dakota*

Adolescent social defeat enhances medial prefrontal cortex D2 autoreceptor function in early adulthood and contributes to reduced medial prefrontal cortex dopamine activity. *Matthew A. Weber, University of South Dakota*

OWS 150 Disrupted cellular-level functional connectivity across primate and mouse models of schizophrenia. *Jennifer Zick, University of Minnesota*

OWS 251 The interface of emotion and cognition in prefrontal cortex. *Steven W. Anderson, University of Iowa*

OWS 257 Mechanisms of blood flow regulation in the central nervous system. *Kyle Biesecker, University of Minnesota*

OWS 275 Understanding the neurobiological implications of historical trauma. *Kathleen Brown-Rice, University of South Dakota*

Poster 1.

The Role of Distress Tolerance in the Relationship Between Cognitive Schemas and Alcohol Problems Among College Students

Rebecca Sistad, Raluca Simons, Jamie Hansen & Jeffrey Simons
University of South Dakota

The current study tested the role of distress tolerance in the relationship between three early maladaptive cognitive schemas (Abandonment, Defectiveness/Shame, and Insufficient Self-Control) and alcohol problems among college students (N = 385). Previous research suggests that maladaptive cognitive schemas may be a risk factor for alcohol-related problems. However, the mechanism underlining this association is unclear. One's tolerance for emotional distress (i.e., distress tolerance) may play an important role in understanding the nature of this association. We tested two models: (1) a moderation model in which distress tolerance was expected to reduce the relationship between maladaptive schema and alcohol problems, and (2) a mediation model in which distress tolerance was expected to mediate associations between early maladaptive schemas and alcohol problems. Results indicated distress tolerance partially mediated the relationships between schemas associated with negative affectivity and alcohol problems. Distress tolerance also significantly moderated the relationship between the Defectiveness/Shame schema and alcohol-related problems, reducing the strength of the association. Distress tolerance is a modifiable risk factor and the results of this study support the inclusion of emotional regulation strategies in the prevention and treatment of alcohol problems among young adults.
Faculty Advisor: Raluca Simons

Poster 2.

Validating an Appropriate Control Method for Assessing Caffeine's Psychotropic Effects in Humans

Stephanie J Brezinski
Winona State University

Overnight abstinence from caffeine use is used as the control group in most human studies. Last year we reported the results of a pilot study that suggested that overnight abstinence did not produce a true caffeine-free control group, but rather a low dose caffeine group. Those results highlighted the need for an alternative method of producing a control group for human caffeine studies. In the present studies, we replicated our previous study and found that 0% of participants were caffeine free following overnight abstinence (M = 852.57 ng/ml). We then went on to complete a study testing the effects of caffeine (46 mg) on learning, memory, anxiety, withdrawal, and pulse after 8 days of abstinence. Daily saliva samples were collected to confirm abstinence. In this study, salivary caffeine levels were reduced to 0 for participants in both the placebo and caffeine groups prior to the administration of caffeine. Subsequent behavioral tests failed to find significant effects of 46 mg of caffeine on learning, memory, anxiety or withdrawal. However, pulse rates were significantly reduced in caffeine treated participants. These data demonstrate a new method for establishing an appropriate control group for assessing caffeine's psychotropic effects in humans.
Keywords: Caffeine learning memory saliva
Faculty Advisor: Richard Deyo

Poster 3.

EEG Peak Frequency of Frontal-Midline Theta and its Association With the Interference Control in Individuals With High Trait Anxiety

Shannon Cavanaugh, Erin Peterson, Salahadin Lotfi, Ken Bennett, Christine Larson, & Han Joo Lee
University of Wisconsin- Milwaukee

Background: Previous studies have shown that the mid-frontal lobe reflects an apparent EEG theta band oscillation driving from the cortico-hippocampal- limbic system, which may indicate an interaction between cognitive and emotional processes. Additionally, it has been shown that individuals with high trait anxiety (HTA) exhibit deficiencies in the theta band frequency compared to healthy control groups (Aftana et al, 2003). Whether there is an association between this deficiency and cognitive performance among individuals with HTA is still unclear. Methods: EEG recordings from 14 channels were conducted on a sample of undergraduate students (N=27) who scored 44 or above on the STAI-Trait Anxiety Inventory. Results: A significant negative correlation was found between selective attention to negative stimuli relative to positive and neutral in the Emotional Stroop task and the frontal- midline theta peak frequency (FTPF; r=-.394*). There were also significant negative correlations between FTPF and three mood questionnaires: DASS21 (r=-.482*), STAIT (r=-.533**), and Rumination Response Questionnaires (r=-.405*). Discussion: First, the strong inverse correlations between anxiety questionnaires and FTPF show the nature of lower activity of FTPF among people with HTA. Second, our data show that lower activity of FTPF in HTA individuals, which is associated with a higher interference in response to negative stimuli in the Emotional Stroop task, may indicate impaired function of the “anterior attentional system” which is known to process voluntary attentional functions. Therefore, a lower FTPF may reflect involuntary increased processing for negative stimuli than neutral and positive.

Aftanas, L. I., Pavlov, S. V., Reva, N. V., & Varlamov, A. A. (2003). Trait anxiety impact on the EEG theta band power changes during appraisal of threatening and pleasant visual stimuli. International Journal of Psychophysiology, 50(3), 205-212.

Faculty Advisor: Han Joo Lee

Poster 4.

The Role of Emotions in Decision Making: How Emotion Affects the Decision Weight Function

Nicole Caicedo
Macalester College

Economic theory often ignores the role of emotion in decision making. However, many studies have shown emotion to be a powerful heuristic used to make decisions. Knowing this, the purpose of this study is to determine the role emotion plays in assigning a subjective weight to each option. As shown in Prospect Theory, when making a decision, individuals place their own subjective weight on each option, called the decision weight, and do so in a predictable manner. This pattern of behavior describes decision weights as a single parameter function. However, this parameter can vary based on current emotional state, an idea supported by neurological and psychological theory. After inducing a state of anxiety in participants via watching a movie clip and then monitoring heart rate to see the change in body state, we observe a dramatic difference in their decision weight curves from being in an emotional and nonemotional state. This leads us to believe the decision weight curve could take on its own unique function for each emotion.
Faculty Advisor: Julia Manor

Poster 5.

Enrichment and Empathy: A Rat Model of Autism Treatment

Jessica Bernstein
Macalester College

Social skills are necessary for successful cooperation, communication, and relationship-building, which puts people with social deficits like those of autism spectrum disorder at a disadvantage. It is of great interest to understand how physical and social environmental enrichment affect social skills and deficits. Rats housed in combinations of physical and social enrichment were tested for behaviors of empathy, an important social skill of processing others' emotions, using a rat-restrainer method. Rats were found to open the restrainer to free the distressed rat fastest across the 12 days of testing when no physical or social enrichment was present, however the absence of physical enrichment mattered more than social enrichment. Rats without social enrichment were observed to have social deficits in play and social behaviors. These results help clarify how the environment affects social skills and suggests that social enrichment is important for proper social interactions and treatment of social deficits.
Faculty Advisor: Julia Manor

Poster 6.

The Effect of Glucose on Self Control in Rats

Jiayin Qu
Macalester Collge

Self-control is an effortful regulation of the self by the self. In the real world, it is sometimes used by animals and humans to gain future desired consequences by delaying immediate pleasure. The purpose of this experiment is to study first the depletion effect after exerting self-control and second the effect of glucose pre-feeding on self-control in rats. The rats were put on differential-reinforcement-of-low-rate (DRL) schedule to inhibit their nose-poking responses by exerting self-control and were then entered into the intolerance-to-delay task to test their self-control. Between the two tasks, the rats were orally fed with glucose, water, or nothing. The study offers a new animal model to study both the depletion effect and the effect of glucose on self-control. After completing the depletion task, the self-control in rats showed no decrease in the subsequent self-control task. Rats in the glucose pre-feeding condition showed an increase of self-control, which was trending toward a marginally significant difference.
Faculty Advisor: Julia Manor

Poster 7.

The Effects of Inhibition of the Medial Prefrontal Cortex on Symptoms of Depression in an Animal Model

Anna Miller
University of Wisconsin-River Falls

Depression is the most widespread disability on Earth affecting more than 350 million people of all ages across the globe (World Health Organization, 2015). 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 (Elliott, & Dolan, 2003; Lemongne et al., 2012). This study investigates the hypothesized link between the medial prefrontal cortex and depression using animal models 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 medial prefrontal cortex –an area which oversees self-referential processing.
Faculty Advisor: James Cortright

Poster 8.

Effects of Mefloquine on Depressive Moods

Michelle Nemeth
Winona State University

Mefloquine is an antimalarial agent that prevents malaria by attacking organisms in the bloodstream. While this drug has been effective in preventing the disease, military personnel who had been given mefloquine reported serious side effects including- but not limited to- mania, depression and anxiety. In this study, 11-12 week old mice were injected with either mefloquine or oil during the dark cycle- the time in which they would be asleep. To assess the overall mood and possible depression levels of the mice, they were suspended by the tail on a plastic rod for six minutes. Each mouse is videotaped and all movement is documented. Subjects with more anxiety experiencing manic-like symptoms will typically display higher levels of mobility, while depressed subjects display decreased mobility levels. Our data was consistent with a depressive effect.
Faculty Advisor: John Holden

Poster 9.

To Drink or Not To Drink? Social Influences in Alcohol Consumption of Adult Rats

Maritza V. Steele
Macalester College

Research has found that individuals are more likely to excessively consume alcohol with peers than alone. Studies have shown that social influence affects behavior in rats; therefore, they may serve as an animal model for how social influence impacts alcohol consumption in humans. Previous research has primarily observed social influence effects in juvenile rats, so this study investigated how social influence affects alcohol consumption in adult rats. This study tested whether rats previously naïve to ethanol solutions would consume more if exposed to a peer rat that had consumed ethanol than those that had not. Rats were tested in one of two conditions: ethanol vs. flavored ethanol or flavored ethanol vs. flavored water. Overall, rats consumed significantly more ethanol than flavored ethanol regardless of peer rat demonstration. Rats consumed significantly more flavored ethanol than flavored water, wherein control rats consumed marginally more flavored ethanol than observer rats. The results, inconsistent with previous research, suggest that demonstration does not increase consumption of ethanol and demonstration of novel flavor does not increase consumption of flavored ethanol. However, neophobia, rat age, and alcohol's reinforcing properties may have influenced this outcome.

Keywords: Alcohol consumption, animal model, social interaction
Special thanks to Julia Manor and Danielle Rutledge for assistance with my research processes.
Faculty Advisor: Julia Manor

Poster 10.

Pain & Exploration: The Allocation of Focal Attention for Competing Noxious and Novel Stimuli

Ethan Carpenter
Macalester College

Patients with chronic pain conditions suffer not only from the constant perception of pain, but from cognitive functional impairment and a decreased quality of life. Their condition arises from the inability to deselect pain, forcing pain to be constantly perceived and inhibiting attention to exteroceptive stimuli. This study aims to make progress towards understanding the mechanisms that are responsible for the constant attention to pain, namely the model of focal attention. Eighteen Sprague-Dawley rats were split into three groups and given formalin injections varying in concentration and observed for behaviors relating to pain and exteroceptive attention. We found a negative correlation between these two behaviors, indicating that they compete for the focal point of attention. These results support other research on the exchange of pain and exteroceptive attention, and suggest that focusing on exteroceptive stimuli during meditation may be a viable alternative to pharmacological analgesics.
Faculty Advisor: Eric Wiertelak

Poster 11.

A Within-Subjects Operant Model to Examine Strength Theory and Ego Depletion in Rats: Effects of Glucose Administration

Alexandra L. Laske
Macalester College

Ego depletion research has viewed self-control as a limited mental resource that may be used up. According to this theory, also referred to as Strength Theory, when this resource is in short supply, self-control may become impaired. Glucose is the main source of energy for brain functioning, and thus would figure strongly in replenishing executive processes. The current study was designed to test the possibility of glucose reversal of ego depletion in rats, in order to shed light on the mechanisms of glucose utilization in the brain and investigate further the possibility of ego depletion in modulating self-control. Using an operant conditioning model, eight female Sprague-Dawley rats completed two weeks of baseline training. Baseline training involved shaping the rats to two levers: a long-delay lever and a short-delay lever. Self-control was measured by the percentage of time that subjects chose the long-delay lever over the short-delay lever. A within subjects design was used for testing. White noise bursts were blasted for 10 seconds per minute for 20 minutes in order to establish ego-depletion. Administration of 0.5 mL of glucose was used for depletion reversal. The current study provides evidence that glucose plays a crucial role in reversing ego depletion. This study may help inform research examining the possibility of ego depletion and glucose in humans, here specifically, the controversy surrounding putative mechanisms of glucose utilization in this effect.
Faculty Advisor: Julia Manor

Poster 12.

Time Cells in the Hippocampus: Neural Ensembles Lost in Time

Caroline Bell[1], Rachel Nordberg[1], Luke Arend[1], Howard Eichenbaum[2] & Adam Johnson[1]
[1]Bethel University; [2]Boston University

Ensembles of time cells are thought to represent an animal's location in time. In order to explicitly test this hypothesis, we decoded the neural representation of time on individual trials of an odor decision task for rats. We used a Bayesian decoding method and found that hippocampal ensembles represented time on the task very well on some trials and not at all on others.
This research is supported by a grant from NIMH to AJ and HE.
Faculty Advisor: Adam Johnson

Poster 13.

Time Cells in the Hippocampus: Spiking Statistics and Tuning Curves

Rachel Nordberg[1], Carrie Bell[1], Howard Eichenbaum[2] & Adam Johnson[1]
[1]Bethel University; [2]Boston University

Neurons in the hippocampus have been found to represent both spatial and temporal information. While the statistics of place cell spiking activity have been well explored, the statistics of time cell spiking activity remain relatively uncharted. We used Poisson statistics and Bayesian inference to build probabilistic tuning curves. This early analysis provides a new way of measuring the temporal information embedded in time cell tuning curves.
This research is supported by a grant from NIMH to AJ and HE.
Faculty Advisor: Adam Johnson

Poster 14.

The Role of Medial Prefrontal Cortex Gap Junction Communication in Retrieval and Extinction of Cocaine Seeking

Michael K. Fitzgerald, Jake L. Burkard, Andrea Gasparini, Austin Anderson & Devin Mueller
University of Wisconsin - Milwaukee

Blocking drug-associated memory retrieval or enhancing extinction of drug-seeking behavior are two strategies that could limit relapse in drug addicts. The loci of retrieval and extinction memory processes include the prelimbic medial prefrontal cortex and the infralimbic medial prefrontal cortex, respectively. The neurochemical and synaptic mechanisms underlying drug-related behavior have received considerable attention, but extrasynaptic mechanisms are relatively unexplored. One form of cellular communication, gap junction communication, may play a role in drug-related learning and memory. Gap junction communication between neurons and astrocytes provide a cytoplasmic continuity between connected cells and both neuronal and astrocytic gap junction communication have been demonstrated to be involved with development and maintenance of the CNS, and also aversive and appetitive paradigms of learning. However, in retrieval or extinction of drug-seeking behavior, the role of gap junction communication is unknown. Here we describe a series of experiments that investigate astrocytic and neuronal gap junction communication in the retrieval and extinction of a cocaine conditioned place preference using microinfusions and confocal imaging.
Faculty Advisor: Michael Fitzgerald

Poster 15.

Cochlear Nerve Myelination in Mice Lacking Thyroid Hormone Transporters

Natalie Moses & David Sharlin
Minnesota State University Mankato

Our lab has been investigating a group of proteins that mediate the transport of thyroid hormone (TH) across the cell membrane and recently found mice lacking two specific TH transporters (Mct8 and Oatp1c1) have normal cochlear development, but altered auditory processing. Specifically, this data demonstrated that the speed at which auditory signals pass from the cochlea to the brainstem were delayed. The experiments performed were designed to test the hypothesis that auditory deficits observed in animals lacking TH transporters Mct8/Oatp1c1 is due, in part, to altered myelination of the auditory pathway. To test this, wildtype and knockout nervous and cochlear tissues were processed and myelin-staining was used to determine the levels of myelination between central and peripheral nervous systems. An important implications for this work is that it will further define the need for thyroid hormone transporters in development to produce normal auditory function which may potentially offer novel modalities for treating deficits associated with low thyroid hormone.
Faculty Advisor: David Sharlin

Poster 16.

Are Hypothyroidism-Induced Reductions in Brain Derived Igf1 Due to Reductions in Serum Growth Hormone?

Alec Wright
Minnesota State University, Mankato

Low thyroid hormone (TH) and low insulin-like growth factor 1 (Igf1) during development result in similar neurological deficits. TH, GH, and Igf1 interact in the body contributing to circulating levels of Igf1. It is proposed that changes in locally produced brain Igf1 following TH insufficiency is due to a disruption of the TH-GH-Igf1 axis. To clarify this, we are testing whether changes in brain Igf1 mRNA is an indirect result of changes in serum GH that accompany low TH. Two groups of pregnant mice will be used: control and hypothyroid. Hypothyroid dams will be treated with chemicals that inhibit thyroid gland function. To test that changes in brain-derived Igf1 following hypothyroidism are independent of changes that occur in serum growth hormone, hypothyroid and control pups will be injected daily with growth hormone or saline until postnatal day 14 when experimental pups will be euthanized. Serum and brain tissue will be collected for analysis of serum hormones and brain Igf1. It is predicted that growth hormone provided to hypothyroid pups will have no effect on the hypothyroidism-induced reductions in brain Igf1; supporting the idea that reduction in brain-derived Igf1 levels following hypothyroidism are independent of the serum growth hormone changes.
Faculty Advisor: David Sharlin

Poster 17.

Effects of Early Adolescent Methamphetamine Exposure on Anxiety-Like Behavior and Corticosterone Levels in Mice

Micaela A. Rud, Thao N. Do & Jessica A. Siegel
University of St. Thomas

Methamphetamine (MA) is an addictive psychomotor stimulant that affects the central nervous system and alters behavior. The effects of MA are modulated by age, and while much research has examined the effects of MA use in adults, relatively little research has examined the effects in adolescents. As the brain is developing during adolescence, it is important that we understand the effects of MA exposure in adolescence. This research examined the effects of acute MA exposure on locomotor and anxiety-like behavior in the open field test and plasma corticosterone levels in adolescent male C57BL/6J mice. Baseline locomotor and anxiety-like behaviors were assessed in the open field test. Immediately following baseline measurements, mice were exposed to saline or 4 mg/kg MA and locomotor and anxiety-like behavior were measured. Serum was collected immediately after testing and plasma corticosterone levels measured. There were no group differences in baseline behavioral measurements. MA-exposed adolescent mice showed increased locomotor activity and anxiety-like behavior in the open field compared with saline controls. There was no effect of MA on plasma corticosterone levels. These data suggest that acute MA exposure during adolescence increases locomotor activity and anxiety-like behavior, but does not alter plasma corticosterone levels.
Faculty Advisor: Jessica A. Siegel

Poster 18.

Neurological and Behavioral Deficits in Hydrocephalic Mouse

Elizabeth Medina & Emma A. Gore
Winona State University

Hydrocephalus is a rare condition in which accumulation of cerebrospinal fluid (CSF) within the brain leads to an enlarged domed head, ataxia, cognitive deficits and depression. Due to the accumulation of CSF, enlargement of the ventricles and herniation of the brain may occur. Hydrocephalus can result from genetic mutations, chemical exposure or infection. This study describes a new case of spontaneous hydrocephalus that occurred in a colony of C57Bl6/j mice. The female hydrocephalic was compared to two female littermate controls and five control females from another litter. Open-field and runway tests were completed to evaluate learning, emotional deficits and motor skills. Photographs were taken to detect differences in head shape and position. Brains were cut at 40 µm and stained to evaluate acetylcholinesterase levels and morphology. Results indicated that the hydrocephalic subject was 352% more active than littermate controls in the open-field. The hydrocephalic had a gait distance of 4.73 cm compared to a gait distance of 5.18 cm for littermate controls. The hydrocephalic was significantly more likely to turn clockwise (95.5%) in the open-field compared to controls (65.3%). This suggests asymmetrical development of the cerebral hemispheres that was confirmed by the histological analysis of the brain.
Faculty Advisor: Richard A. Deyo

Poster 19.

The Effects of Enriched Environment on the Response to Methamphetamine in Adolescent and Adult Mice

Ashley Dahly, Elizabeth Baker, Elliott Magnuson & Jestine Weiss
University of St. Thomas

Methamphetamine (MA) has neurotoxic effects on the adult human brain that can lead to deficits in behavior and cognition. Long-term exposure to MA also alters the stress response and hypothalamus-pituitary-adrenal axis function. The rising rates of adolescent MA use make it imperative that we understand the long-term effects of MA exposure on the adolescent brain and how these effects may differ from those seen in adults. Rearing in an enriched environment reduces MA seeking behavior, MA self-administration, and MA cue-induced reinstatement in adult rodents. However, relatively little research has examined the effects of MA on adolescent behavior and how housing environment might alter the behavioral response to MA in adolescence. In order to assess age differences in the response to MA and the possible effect of housing environment on the response to MA, this research examines the long-term effects of MA exposure during adolescence or adulthood on behavior and plasma corticosterone levels in male C57BL/6J mice housed singly in standard housing conditions or housed in groups in enriched environments. Because the adolescent brain is still developing, we expect that the MA-induced behavioral and corticosterone alterations in adulthood will be less severe than those observed in adolescence. Furthermore, we predict that housing in an enriched environment will mitigate the effects of MA in both age groups, but that this effect will be more pronounced in the adolescent mice. These findings will contribute to a greater understanding of how MA alters behavior in an age group that has been relatively understudied and how an enriched environment might alter the response to MA.

These studies supported by: The University of St. Thomas Startup Laboratory Funding.
Faculty Advisor: Jessica Siegel

Poster 20.

Developing A Light Induced Locomotor Assay to Characterize HPA Axis Activity in Larval Zebrafish

Jennifer L. Gauerke, Han B. Lee, Tanya L. Schwab, Ashley N. Sigafoos, MaKayla R. Serres & Karl J. Clark
Winona State University, Mayo Clinic

The hypothalamic- pituitary- interrenal (HPI) axis is the central stress response in zebrafish, which is the functional homologue to the hypothalamic- pituitary- adrenal (HPA) axis in human beings. The zebrafish model can be used to study HPA axis dysfunction, as seen in neuropsychiatric disorders such as depression, anxiety, schizophrenia, and bipolar disorder. The present study evaluated the neurophysiology of the HPI axis in zebrafish that have been modified using frameshift mutations to the HPA axis. The nr3c1 mutant (glucocorticoid receptor deficit; blocks effect of cortisol in cells) and mc2r mutant (ACTH receptor knockout) were tested in a new, complimentary, non-chemical based locomotor assay using infrared and white light. We hypothesized that abrupt changes in light (stress) would increase locomotion through activation of the HPA axis. As predicted, white light stress increased locomotion in wild-type larval zebrafish. It also decreased locomotion in zebrafish mutants (mc2r and nr3c1) with impaired HPA axes. Therefore, white light can be used as a non-chemical stressor to induce locomotion in larval zebrafish through activation of the HPA axis.
Faculty Advisor: Karl J. Clark

Poster 21.

The Effect of Steroid Hormones on Neuronal Size and Number in Two Brain Regions Important for Reproduction

Jaeyoung Son, Hyejoo Kang & Rachel E. Cohen
Minnesota State University Mankato

Steroid hormones, such as testosterone (T) and its metabolites (estradiol, E2, and dihydrotestosterone, DHT), are critical for the production of reproductive behavior. These hormones play a role in neural plasticity, such as changes in neuronal size change and brain region volume. Our study is examining the role of steroid hormones in maintaining the morphology of brain areas involved in reproduction, such as the ventromedial hypothalamus (VMH) and preoptic area (POA). We are using the green anole lizard (Anolis carolinensis) as a model because they are seasonally dimorphic, with more reproductive behaviors and higher steroid hormones in the breeding compared to non-breeding season. We treated our animals with different steroid hormones: T, DHT, E2, and blank capsules as a control. We collected the brains, sectioned the tissue and measured neuron size, number and density in the VMH and POA. We are expecting to find smaller and increased numbers of neurons in the animals treated with steroid hormones compared to the controls. This result would support the idea that steroid hormones are critical for the maintenance of brain areas important for reproduction.
Faculty Advisor: Rachel E. Cohen

Poster 22.

Social Attachment and the Relationship to Salivary Oxytocin

Lauren R. Koch
Winona State University

Oxytocin plays a significant role in human reproductive and mating behavior. Romantic love is a subjective human experience that has also been linked to oxytocin physiology. A sample of 38 college students (9 male and 29 females) between the ages of 18 and 33 years of age were administered surveys that evaluated the quality and satisfaction of their romantic and platonic relationships. A saliva sample was then obtained from participants. Samples were stored at -80 C for up to eight months prior to analysis for oxytocin content. Participants that were in monogamous relationships were significantly more satisfied with their romantic relationships than participants in non-monogamous relationships ($t(18)= 3.959$, $p < .05$). Although there was a significant correlation between satisfaction with the relationship and sexual frequency ($r(20)= .481$, $p < .05$) there was not a significant difference in the frequency of sex between the two groups ($t(26)= .112$, $p > .05$) suggesting that relationship satisfaction is not dependent on sex. Surprisingly, oxytocin levels were not significantly different between groups ($t(26)= .602$, $p > .05$) suggesting that oxytocin may plays less of a role in romantic relationships than previously reported.
Faculty Advisor: Richard A. Deyo

Poster 23.

The Effect of Water Restriction on Courtship Singing and the Neuroendocrine Mechanisms of Song Production in Male Zebra Finches

Hannah M. Moyer & Sarah A. Heimovics
University of St. Thomas, St. Paul

Zebra finches (Taeniopygia guttata) are opportunistic breeders. Their gonadal development and reproductive behavior is closely tied to water availability. These Australian desert birds are highly social and form year-round, long-term monogamous pair-bonds independent of environmental conditions. The effect of water availability on courtship singing in unpaired male Zebra finches was studied by comparing two treatment groups: water-restricted or ad libitum access to water. Six weeks later subjects were presented with a female conspecific through a wire partition. The number of directed songs (a highly sexually motivated form of singing behavior) produced over the course of 30min was quantified. We found that WR males sang significantly fewer directed songs than CON males ($p = 0.0008$). The neuroendocrine mechanisms underlying this effect of water restriction on sexually motivated song production was studied next. The neurotransmitter dopamine is well established as a modulator of highly motivated, goal directed behavior, including sexually motivated singing behavior. pTH is considered as an indirect measure of dopamine synthesis. A pTH immunohistochemistry was used to investigated the relationship between water restriction, courtship singing, and dopaminergic neurotransmission. It is predicted that WR males will have significantly lower levels of pTH in brain regions implicated in sexually motivated singing behavior.
Faculty Advisor: Sarah Heimovics

Poster 24.

Analysis of Amygdala Morphology and Neurogenesis in Green Anole Lizard in Breeding Versus Non-Breeding Season.

Jaden Roddick, Abodalrahman Mohammad Algamdy & Rachel Cohen
Minnesota State University, Mankato

Steroid hormones and their derivatives play a major role in the reproductive system. Because the amygdala is responsible for reproductive behaviors, we will use this area of the brain to retrieve desired data. We are examining the relationship between steroid hormone and neuron size, number and neurogenesis in the amygdala. We are using the green anole lizard (Anolis carolinensis) as a model organism to study neurogenesis. Green anoles are seasonally breeding animals and exhibit unique behavioral and physiological differences in the breeding season compared to the non- breeding season. These behavioral differences are likely caused by seasonal changes in circulating steroid hormone levels. Green anoles were caught in natural habitat during the breeding season, transferred to the laboratory, and gonadectomized. A capsule containing either testosterone, estradiol, or left empty was inserted under the anole's skin. The animals were injected with BrdU for three days after the treatment. After one month, brains were collected, sectioned, and placed on slides. BrdU, Hu, and Nissl stains were applied to the slides to display the presence of new neurons, cell number and soma size. We expect to see a decrease in neuron number in the amygdala during the breeding season.
Faculty Advisor: Rachel Cohen

Poster 25.

Effects of Aromatase Inhibition on Singing Behavior and Pth Levels in Breeding Season European Starlings

Ellen Goding & Sarah Heimovics
University of St. Thomas

In songbirds, steroid hormones such as testosterone (T) and estrogen (E2) and more recently Dopamine (DA) play an important role in the seasonal modulation of vocal communication. Evidence shows that DA and E2 can interact to control sexually motivated behavior but, to date, this interaction has not been directly established. Baseline singing behavior was quantified using a point sampling technique in early breeding season male European starlings. Then subjects were randomly selected to receive injections of either saline (CON) or fadrozole (FAD, an aromatase inhibitor) and singing behavior was then quantified 18hr following each injection. Brains were collected immediately following the last behavioral observation and processed for immunohistochemistry for the active form of the rate-limiting enzyme in DA synthesis, phosphorylated tyrosine hydroxylase (pTH). pTH levels in relevant brain nuclei were then quantified in CON and FAD males. Within-subjects Anova revealed that CON subjects increased their song rate while FAD subjects did not. In parallel, FAD-injected males had significantly lower pTH levels in Central Gray (GCt), medial bed nucleus of the striatus terminalis (BSTm), HVC (proper name), robust nucleus of the arcopallium. (RA). Taken together, these data suggest that E2-DA interactions regulate sexually motivated vocal communication in male European starlings.
Faculty Advisor: Sarah Heimovics

Poster 26.

Social Dominance During Mate Competition Relates to Dopaminergic Gene Expression in Social Behavior Network Nuclei in Male Zebra Finches.

Stephanie Eswine, Jill Pontinen & Sarah Heimovics
University of St. Thomas, St. Paul, MN

Dopamine (DA) is a neurotransmitter that influences a range of social behaviors, however, little is known about how dopaminergic neurotransmission differs in dominant and subordinate individuals. DA is produced in multiple brain regions, including the ventral tegmental area (VTA). The VTA has been implicated in the regulation of highly motivated, goal-directed behaviors including dominance and aggression. The VTA projects to other social behavior network (SBN) nuclei including the preoptic area (POA), bed nucleus of the stria terminalis (BST), lateral septum (LS), and anterior hypothalamus (AH). RT-qPCR was used to examine the relationship between social dominance and mRNA expression for tyrosine hydroxylase (TH) and the D1 DA receptor within the SBN nuclei. Male zebra finches were randomly assigned to dyads and underwent a mate competition paradigm for three days to identify the dominant and the subordinate individuals. It was found that expression of TH within VTA is significantly higher in dominant individuals compared to subordinates ($p<0.03$). In POA, D1 expression is significantly higher in dominant individuals ($p<0.01$). It is clear that dopaminergic neurotransmission is important in the differentiation of behavior in dominant and subordinate individuals and plays a role in social hierarchies.
Faculty Advisor: Sarah Heimovics

Poster 27.

Seasonal Variation in the Dorsolateral and Medial Cortex of Green Anole Lizards.

Amber B. Day & Abdiasis D. Abdilahi
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The hippocampus is a region of the brain involved in spatial learning and memory, and has been shown to add new neurons in adult animals. Steroid hormones, specifically testosterone (T) and its metabolites (estradiol, E2, and dihydrotestosterone, DHT), have been shown to play a role in the addition of adult-born neurons to the brain. The green anole lizard, Anolis carolinensis, is a seasonally breeding animal that exhibits seasonally dimorphic behaviors, as well as seasonal anatomical differences in the brain. The pronounced differences between the breeding and non-breeding seasons make this lizard an excellent model for the study of how steroid hormone differences impact the brain. We examined the volume of and addition of new adult-born neurons to the dorsolateral and medial cortex in the lizard, which is analogous to the mammalian hippocampus. We sectioned brain tissue from breeding and non-breeding animals, performed a Nissl stain, and are measuring volume of the regions. We expect that the region will be larger in the breeding season due to the increase of territorial and courtship behaviors. We also treated animals with T, DHT, E2 or nothing as a control and performed an immunohistochemistry to examine how steroid hormones impact neurogenesis. We expect to see significantly more neurogenesis in the dorsolateral and medial cortex of T, DHT, E treated animals in comparison to the untreated group. Our experimental results may provide a greater understanding of the mechanisms that regulate the neural control of reproduction and territorial behaviors.
Faculty Advisor: Rachel Cohen

Poster 28.

17β-Estradiol Activates the Wnt/B-Catenin Pathway in the Dorsal Hippocampus of Ovariectomized Female Mice

Molly M. Kiefer, Lisa R. Taxier, Ashley M. Fortress & Karyn M. Frick
University of Wisconsin- Milwaukee

Females are more susceptible to age-related cognitive decline than males due to the loss of circulating estrogens at menopause. Understanding how estrogens regulate memory could provide beneficial information for creating new treatments for memory dysfunction. Within the dorsal hippocampus (DH), a brain region implicated in memory processes, the potent estrogen 17β-Estradiol (E2) mediates activation of several cell-signaling pathways. This activation is necessary for E2 to enhance memory consolidation in female rodents. The Wnt/β-catenin pathway, which regulates hippocampal development and synaptic plasticity, is necessary for memory consolidation. However, the extent to which E2 interacts with Wnt/β-catenin signaling to facilitate memory is not well understood. To characterize whether E2 activates Wnt/β-catenin signaling in the DH, ovariectomized female mice were infused with vehicle or E2 into the DH, and the DH collected at various time points afterwards. Using Western blotting to quantify changes in target Wnt/β-catenin proteins and a PCR array to quantify changes in mRNA expression, we demonstrate that E2 can regulate aspects of the Wnt/β-catenin pathway. Future studies will explore these interactions by studying the effects of the Wnt inhibitor, Dkk-1 on protein levels and mRNA expression.
Sponsored by UWM College of Letters and Science & Office of Undergraduate Research
Faculty Advisor: Karyn Frick

Poster 29.

NF Kappa B Activation is Dependent on Mtorc1 in Neurons and Endothelial Cells

Leah Brownlee, John Reho, Deng Guo, David Lo & Kamal Rahmouni
Coe College and University of Iowa

The mechanistic target of rapamycin complex and nuclear factor kappa B signaling pathways play an essential role within hypothalamic neurons in controlling energy homeostasis and blood pressure. Despite the importance of these pathways, little is known about whether or how they interact to carry out their downstream effects. In the current study we used a neuronal cell line to investigate interactions between mTORC1 and components of the NF-kB signaling pathway. Our results demonstrate that mTOR physically interacts with IKK, and TNF alpha-mediated NF-kB activation is inhibited by rapamycin, suggesting that NF-kB signal transduction is dependent on mTORC1.
Faculty Advisor: David Lo

Poster 30.

The Role of the Medial Prefrontal Cortex in Estradiol-Mediated Enhancement of Object Memory Formation in Female Mice

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Department of Psychology, University of Wisconsin-Milwaukee, Milwaukee, WI

Systemic injection or dorsal hippocampal infusion of the potent estrogen 17β-estradiol (E2) can improve memory in ovariectomized (OVXed) female mice. Estrogen receptors are also expressed in other brain regions important for memory formation, including the medial prefrontal cortex (mPFC), and the role of the mPFC in E2-mediated memory enhancement is unknown. To address this question, female mice were OVXed and implanted with bilateral cannulae aimed at the mPFC. Mice were then tested in object recognition (OR) and object placement (OP), E2-sensitive tasks routinely used to evaluate object recognition and spatial memory in rodents. Immediately after training in each task, mice were infused with 5μg/hemisphere E2 or vehicle. Memory retention was then tested 48 or 24 hours later, as vehicle-treated OVXed mice do not remember the familiar or unmoved object location at these delays, whereas OVXed mice infused with E2 into the DH do. In the present study, we found mice infused with E2 into the mPFC had intact OR and OP memory, whereas vehicle-treated control mice did not. These data demonstrate that E2 infused directly into the PFC can enhance both OR and OP memory, and provide critical new insight into the estrogenic regulation of memory in female mice.
Faculty Advisor: Karyn M. Frick

Poster 31.

The Effect of Fadrozole on Female Directed Behavior and Tyrosine Hydroxylase Expression in the Midbrain Central Gray (Gct) of Male European Starlings (*Sturnus vulgaris*)

Georgianne Younger, Dacotah Anderson & Sarah Heimovics
University of St. Thomas

The role that androgens such as Testosterone (T) and its subsequent metabolite, 17β-Estradiol (E2), have on breeding season aggression is well established. Through genomic and non-genomic mechanisms, research has suggested that E2 can influence the physiology and sexually motivated behavior of various male species [1]. To focus on the direct influence of E2 on sexually motivated and aggressive behavior, however, the use of non-steroidal inhibiting drugs has been utilized. The effects of the drug fadrozole hydrochloride (FAD), which works through the inhibition of the aromatase enzyme, has been successfully implemented and analyzed within various species [4,5]. Here, through the establishment of a male-pair bonding scheme to force the presence of a dominance hierarchy, we directly test the acute and chronic effects of FAD on the dominant male. Gaining access to a female is a goal-directed behavior, often associated with dopaminergic neurotransmission [6]. It is seen that the total orientation time of the dominant male towards the stimulus female significantly increased after the chronic administration of FAD relative to the baseline testing days as well as a strong trend observed in the number of barrier contacts by the dominant male. The midbrain central gray was analyzed for tyrosine hydroxylase, the rate-limiting enzyme in dopamine synthesis, protein levels using a western blot [5]. Results showed that Fadrozole significantly increased the expression of this enzyme. As an androgen response element lies upstream of the TH gene, it follows that increased androgen levels due to FAD treatment upregulated the expression of the gene and synthesis of dopamine [5]. These data suggest that the chronic administration of FAD may have increased the levels of circulating androgen in the bloodstream leading to increased dopamine, thus increasing female directed behavior and also an increase in dominant behaviors.

Faculty Advisor: Sarah Heimovics

Poster 32.

Intrahippocampal Infusion of 17beta-Estradiol or an Agonist of the G-Protein Coupled Estrogen Receptor Increases CA1 Apical Spine Density in Ovariectomized Female Mice.

Jayson C. Schalk, Jaekyoon Kim, Wendy A. Koss & Karyn M. Frick
University of Wisconsin-Milwaukee

The hippocampus is a medial temporal lobe structure that mediates the formation of many types of memories and that deteriorates in aging and Alzheimer's disease. The dendrites of excitatory neurons in the hippocampus are covered in spines, which allow these neurons to increase connectivity with other neurons, thereby, facilitating memory consolidation. Estrogens are important neurotrophic factors for hippocampal neurons, and the potent estrogen 17□-estradiol (E2) significantly increases dendritic spine density in the hippocampus. Loss of estrogens in menopausal females is associated with an increased risk of memory loss, possibly due to a reduction in hippocampal spine density. However, the mechanisms regulating hippocampal dendritic spine density are unknown. This study investigated the effects on hippocampal dendritic spine density of a bilateral intrahippocampal infusion of vehicle, E2, or the G-protein coupled estrogen receptor (GPER) agonist G-1. Forty minutes after infusion, brains were collected and neurons visualized using Golgi staining. Spines were then counted in the CA1 region using NeuroLucida. Both E2 and G-1 increased the number of dendritic spines on apical dendrites of CA1 pyramidal neurons, suggesting that both E2 and GPER activation can increase CA1 spine density. Ongoing studies are determining the molecular mechanisms regulating the spinogeneic effects of these compounds.
Faculty Advisor: Karyn M. Frick

Poster 33.

Wnt/B-Catenin Signaling is Necessary for E2-Mediated Memory Enhancement

Sarah M. Philippi, Lisa R. Taxier & Karyn M. Frick
University of Wisconsin-Milwaukee

Estrogens mediate the function and morphology of the hippocampus, a brain region important for learning and memory. In the dorsal hippocampus, the potent estrogen 17β-estradiol (E2) facilitates memory through the activation of cell-signaling cascades. The Wnt/β-catenin cell-signaling pathway regulates hippocampal development and synaptic plasticity. Our lab previously showed that blockade of Wnt/β-catenin signaling with Dickkopf-1 (Dkk-1) impairs object recognition memory in male mice (Fortress et al, 2013). However, the potential involvement of Wnt/β-catenin signaling in the memory-enhancing effects of E2 are unknown. To address this issue, 10 week-old ovariectomized female C57BL/6 mice were trained on object recognition (OR) and object placement (OP) tasks designed to test object recognition and spatial memory. Immediately after training, mice received bilateral infusions of vehicle or Dkk-1 into the dorsal hippocampus and unilateral infusion of vehicle or E2 in the dorsal third ventricle. Memory was tested 24 or 48 h later. In contrast to mice receiving infusions of E2+vehicle, those receiving infusions of E2+Dkk-1 did not exhibit intact memory consolidation in either task. These results indicate that Wnt/β-catenin signaling is necessary for the memory-enhancing effects of E2 in female mice. Future studies will characterize the effects of E2 on Wnt/β-catenin signaling in the dorsal hippocampus.

Sponsored by the University of Wisconsin-Milwaukee College of Letters and Science and Office of Undergraduate Research
Faculty Advisor: Karyn M. Frick

Poster 34.

Differential Spinal Retinoic Acid Receptor-Beta Expression in Response to Carrageenan-Induced Hyperalgesia in Mice

Kaan Salçın & Lin Aanonsen
Macalester College

Central and peripheral injuries or illnesses can result in lasting changes in the central nervous system that lead to persistent stimulation of pain conducting systems, potentially resulting in disorders such as chronic pain. If these lasting changes permanently affect spinal excitability, they are collectively referred to as central sensitization. Retinoic acid receptors (RARs) have been implicated to play an essential role in long-term potentiation in the hippocampus, and given the similar molecular mechanisms underlying neuroplasticity contributing to memory and persistent pain, RAR is likely to be involved in the modulation of inflammatory responses. This study focuses on how carrageenan-induced inflammation affects the expression levels of RAR-beta in nociceptive spinal neurons. The findings reveal that RAR-beta expression does not change in response to spinal inflammation. Future research in this field holds the potential to shed light on pathophysiology of chronic pain, and therefore, pharmacology of pain management.
Faculty Advisor: Eric Wiertelak

Poster 35.

Effect of Isoflurane Anesthesia on Head Direction Cell Firing and Spatial Orientation

Jessica Johnson, Matthew Ramsey, Elliott Curd & Gary Muir
St. Olaf College

Head direction Cells (HDCs) encode the direction an animal faces by greatly increasing firing in that direction. In order to investigate intrinsic connection properties of the HDC attractor network and internal memory, we studied HDC firing rates before, during, and following recovery from anesthesia. Using extracellular electrodes, 31 HD cells were recorded from the anterodorsal thalamic nucleus of three rats. The preferred firing direction of a HDC was first identified in a baseline session where rats navigated a cylindrical environment with a prominent landmark, followed by a 90° counterclockwise rotation session. For the last session, rats were anesthetized via isoflurane and regained consciousness in the environment without cues. Our analysis indicates HDCs fired non-randomly while anesthetized and randomly adopted a new firing direction following anesthesia. We propose the non-random firing during anesthesia indicates attractor network properties are still partially active during anesthesia, maintaining some consistent spatial relationships between HDCs.
Faculty Advisor: Gary Muir

Poster 36.

The Effects of Mild Traumatic Brain Injury on Neurotrophic Factor Expression in the Limbic System

Aaron Fleischer, Laura Fox, Nate Vinzant & Gina Forster
The University of South Dakota

Many humans receiving mild traumatic brain injuries (mTBIs) suffer anxiety post-injury. mTBIs occur in stressful situations, promoting release of glucocorticoids, which activate both mineralocorticoid (MRs) and glucocorticoid (GRs) receptors. Low GR activation increases brain-derived neurotrophic factor (BDNF) production – promoting neuron survival – whereas high GR activation decreases BDNF concentrations. mTBI in a rat model increases neuron counts in the medial (MeA) and basolateral (BLA) regions of the amygdala – areas with many GRs – but reduces neurons in the hippocampal CA1 – an area with fewer GRs – suggesting BDNF alteration in these regions. Our hypotheses were that mTBI would decrease and increase BDNF in the hippocampus and amygdala, respectively, mediated by GR activation. Rats received either vehicle solution, MR-antagonist, or GR-antagonist, and social defeat and mTBI surgery. Controls did not receive defeat or injury. Anxiety-like behaviors were assessed via elevated plus maze. Finally, the rats' brains were immunohistochemically stained for BNDF and NeuN, imaged, and analyzed. Preliminary results support our hypotheses, suggesting mTBI promotes psychological effects by impacting BDNF and neuron counts in the limbic system. Concluding this study, we hope to better understand the mechanism behind anxiety responses post-mTBI.
Aaron Fleischer was supported by a fellowship from the SPURA program (NIH NIDA R25-DA033674).

Faculty Advisor: Gina Forster

Poster 37.

The Influence of Auditory and Cognitive Factors on Cochlear Implant Rehabilitation

Brock Carlson, Annelise Coffey, Maria Paula Rodriguez, Anna Ruehlow & Jeremy Loebach
St. Olaf College

There is a wide range of unexplained variability in Cochlear Implant (CI) users' ability to accurately perceive speech and environmental sounds. The present study developed a battery of tests to explore cognitive factors, or "X-Factors," that may contribute to variability in CI users' performance. Eighteen participants comprised of undergraduate students and community members completed tasks assessing working memory, listening effort, and cognitive load. These tasks included an environmental sound task, a general cognitive health assessment, and a personality inventory. Pupillometry measurement was used to gauge listening effort and cognitive load during the digit span, PASAT, and QuickSIN tasks. There was a significant association between participants' performance on environmental sound identification and accuracy on the PASAT. This association may indicate that listening effort is a cognitive factor that offers versatility. In the future, this battery will be administered to CI users to identify processing strategies that help or hinder their performance.
Faculty Advisor: Jeremy Loebach

Poster 38.

Increase in the Protein Levels of an Anti-Sprouting Factor and Integrin Receptor, Thy-1, With Age in the Supraoptic Nucleus: Implications for a Role in Collateral Axonal Sprouting

Talia Dalzell, Molly Pignato, Nadia Toumeh, Phil Kuball, M. Gus McCarthy, Erik Bye, Shelby Rolfhus & Jason Askvig
Concordia College

It has been demonstrated that a young brain can overcome injury by axonal sprouting; however, the mature brain has a reduced capacity for functional or structural reorganization following injury. To this point, following injury, uninjured axons from the supraoptic nucleus (SON) undergo collateral axonal sprouting in the 35-day-old rat, but not in 125-day-old rats. Therefore, it appears that within the SON there are age-related changes that preclude the older rat from recovering following injury. Cell adhesion molecules have been previously demonstrated to play a role in axonal sprouting, both in a stimulatory and inhibitory manner. Thus, we compared protein levels of the integrin family of cell adhesion molecules and the integrin receptor, thy-1, in 35 and 125-day-old SON using Western blot analysis. Our results demonstrated that in the 125-day-old SON, there was a significant increase in thy-1 protein levels, which is an anti-sprouting factor that interacts with integrins. Conversely, there were no changes in the protein levels of alpha v, beta 3, or beta 5 integrin. Our results suggest that the observed increase in thy-1 protein levels in the SON with age may contribute to an environment that prevents the collateral axonal sprouting in the SON of an older rat.
Faculty Advisor: Jason Askvig

Poster 39.

Analgesic and Anti-Inflammatory Effects of Aqueous and Organic Extractions of *Cornus officinalis* Fruit

Eshaan Iyer
Macalester College

For centuries, Cornus officinalis has been used to combat chronic pain in China, Korea, and Japan. In this study, the anti-inflammatory and analgesic effects of C. officinalis fruit was investigated by evaluating the efficacy of organic and aqueous extracts of C. officinalis fruit in reducing pain behaviors in rats in a formalin model of pain. A one-way ANOVA with repeated measures found a significant difference between the control, aqueous, and organic groups with post hoc analysis suggesting a statistically significant reduction in pain behaviors between the aqueous and control groups, the organic and control groups, and the organic and aqueous groups, respectively. These reductions in pain behaviors were observed across both the acute and ant-inflammatory phases of the formalin pain test. These results provide evidence that both organic and aqueous fractions of C. officinalis extract contain analgesic and anti-inflammatory phytochemicals.
Faculty Advisor:

Poster 40.

The Effects of Nefiracetam on Drug-Induced Impairment of Learning in Rats Using a Morris Water Maze

Vaishnavi Madhavan
Macalester College

Alzheimer's Disease patients display cholinergic deficiencies commonly treated using cholinesterase inhibitors. Nootropics (cognitive enhancement drugs), such as nefiracetam, have similar mechanisms of action to cholinesterase inhibitors. This paper explores how chronic administration of nefiracetam affects learning and memory and how it interacts with the muscarinic cholinergic receptor. There were 24 female Sprague-Dawley rats that were divided into 2 long-term-treatment groups, saline or nefiracetam. On day 6 each rat did 10 trials in Morris water maze. On day 7, they were additionally given a short-term treatment, scopolamine or saline, 20 minutes prior to entering the Morris water maze. Latency to platform for each trial was recorded. The nefiracetam group showed enhanced learning exhibited by shorter latencies to the platform compared to the saline group, but the results were not statistically significant. Future researchers may consider increasing the dose of scopolamine to test how or if nefiracetam works to ameliorate the memory impairment it causes.
Keywords: nefiracetam, scopolamine, learning, memory, Morris water maze.
Faculty Advisor: Eric Wiertelak

Poster 41.

Investigations of the Role of Gut Microbiota Modulation on Anxiety

Hannah J. Harder
Macalester College

The neuroscience of anxiety is increasingly complicated, with complex interactions between genetic and environmental factors. The gut microbiota can act as a modulator of mental health through host-microbiota interactions. Gut microbiota modulation, through antibiotic or probiotic use, may serve as an alternative treatment to traditional anti-anxiety medications, as both have shown decreased anxiety effects on the elevated plus maze (EPM). The effects of gut microbiota modulation on different baseline anxiety levels is not known. In this protocol, rats were pretested on the EPM to determine baseline anxiety, and then were treated with antibiotics or high-strength/short-course probiotics. Rats were evaluated at the end of treatment for differences in anxiety. Antibiotic tests showed high-anxiety rats with decreased anxiety and low-anxiety rats with increased anxiety, but no difference between antibiotic-treated animals and controls, or between different anxiety levels. Probiotic treatment also showed high-anxiety rats with decreased anxiety and low-anxiety rats with increased anxiety. There was no difference between probiotic-treated animals and controls, but there was a differential effect of treatment on different anxiety levels, largely due to effects from the high-anxiety group. Together, these results suggest that differences in anxiety seen across trials are likely due to repeated exposure to the EPM alone, creating decreased anxiety for high-anxiety rats and increased anxiety for low-anxiety rats. The probiotic treatment did suggest an effect of lowered anxiety on high-anxiety rats, but no significant effect for low-anxiety rats. Future studies could utilize high-anxiety rats alone to determine if that creates a significant drug effect, and to determine if probiotic treatment serves as an anxiolytic for high-anxiety rats alone. Further research will be necessary to explore potential anxiolytic properties of antibiotics and probiotics, and to explore the different responses of varying anxiety levels to repeated exposure on the elevated plus maze.
Faculty Advisor: Eric Wiertelak

Poster 42.

Should Hoarders Lose Their Homes?

Nicholas Egersdorf
Macalester College

Hoarding Disorder (HD) is a set of behaviors tied to maladaptive neurological and cognitive processes that typically result in accumulations of clutter that are problematic to the self and others. With more than 12 million Americans exhibiting HD symptoms, prevalence is strikingly disproportionate to the level of cultural awareness. The purpose of this project was to provide an unbiased account of the current scientific and legal literature surrounding hoarding as a disorder and as a disability. The second part of the project provides a thorough philosophical argument that HD is a disability that warrants reasonable accommodation, and then considers the nature of reasonable accommodation for hoarders. Ultimately, I came to the conclusion that HD warrants reasonable accommodation insofar as it promotes healing on an individual and societal level. In general, hoarders should not have to lose their houses, however when symptoms are persistently problematic, commitment to a facility is the best possible option.
Faculty Advisor: Joy Laine

Poster 43.

Establishing a Cell Culture Model to Investigate Central Nervous System Inflammatory Mechanisms

Kelsey Kornacker, Myranda Anderson, Tucker Dangremond & David Lo
Coe College

Neuroinflammation is involved in the pathogenesis of many neurodegenerative diseases, including multiple sclerosis, Parkinson's disease, and Alzheimer's disease. Thus, a better understanding of neuroinflammatory mechanisms is crucial for developing novel intervention strategies for a host of neurological disorders. Our goal was to establish a cell culture model that mimics neuroinflammation and neurodegeneration within the brain to study disease processes and be able to test the efficacy of intervention strategies. We investigated the role that various brain cells, microglia, astrocytes, and endothelial cells, play in promoting neuroinflammation, and examined the link between neuroinflammation and neurodegeneration. By stimulating various cell types with inflammatory agents like cytokines and lipopolysaccharide, we determined that microglia are the primary mediators of neuroinflammation; and when activated, produce factors that are toxic to neurons. In addition, we worked out parameters for inducing neurodegeneration and performed quantitative PCR to elucidate the molecular mechanisms that drive neuroinflammation. In the end, we established a working model that allows us to investigate cellular interactions within the context of neuroinflammation and neurodegeneration, and established appropriate end-point measures to provide mechanistic insight into how neuroinflammation arises and precipitates disorders of the nervous.
Faculty Advisor: David Lo

Poster 44.

Sociosexual Motivation Deficits in the Absence of Olfactory Dysfunction in the Pink1 -/- Rat Model of Parkinson Disease

Haleigh Mulholland, Meghna Kurup, Katie Yang & Michelle Ciucci
University of Wisconsin-Madison

Sexual dysfunction and lack of motivation are two prominent non-motor symptoms of Parkinson Disease (PD). The Pink1 -/- rat model for PD demonstrates progressively worsening deficits in motor function and 50 kHz ultrasonic vocalizations. The protocol to elicit these 50-kHz calls uses a sociosexual paradigm, and the contribution of sexual dysfunction to communication interactions within this model is unknown. 18 male Pink1 -/- animals and 12 age matched wild-type (WT) controls were assayed for sociosexual interest at 6, 8, and 10 months of age. Each animal was placed with a sexually receptive female and several variables were analyzed to obtain a composite sociosexual score (e.g latency to mount, time sniffing female, etc). To detect confounding factors, we also tested olfactory discrimination. We found that the Pink1 -/- animals had significantly increased latencies to mount and decreased composite sociosexual scores as compared to WT controls. However, there were no significant differences in olfactory discrimination or time spent sniffing the female between WT and Pink1 -/- rats. This indicates that the animals' decreased interest in social or sexual interaction is likely not due to deficits in olfaction. This suggests that the Pink1 -/- rat experiences sexual dysfunction that may contribute to deficits in social communication.
Faculty Advisor: Michelle Ciucci

Poster 45.

Exploring the Neurochemical Correlates of Alzheimer's Disease (AD) in Cotton Top Tamarins (*Saguinus oedipus*)

Laura Somppi
Carleton College

Brain sections were analyzed from 2 cotton top tamarins, one aged and one middle aged control. Sections (40 micron-thickness) were stained with Nissl for cell body and cell area counts, and with 2 mouse monoclonal antibodies (6E10 and AT8) created to attach to beta amyloid plaques and neurofibrillary tangles (NFT), respectively. The elderly monkey's brain showed less area per cell as well as significntly higher beta amyloid plaques and NFT's in areas involved in thinking and memory.
Faculty Advisor: Julie Neiworth

Poster 46.

Using In-Situ Hybridization to Localize FAM171B Expression.

Brooke Jones, Ashani Sudasinghe, Geoffrey Goellner & David Sharlin
Minnesota State University

The neurodegenerative disorder Huntington's disease (HD) is a progressive and fatal disorder categorized by repeats of CAG (amino acid glutamine-Q) in its primary amino acid sequence. In afflicted individuals, these "polyglutamine" (polyQ) stretches expand beyond their normal ranges, leading to brain cell death, and are inferred to be the main cause of the pathological effects of HD. This is of particular interest in our lab because an uncharacterized protein, FAM171B, contains a polyQ stretch and is believed to function within the brain. Henceforth, the purpose of our research is to determine whether or not FAM171B is present in brain tissue. We will utilize In-situ hybridization, a technique that allows for the localization of expressed genes within certain body tissues. We will "fix", "slice" and then "probe" tissues of mouse brain in search of evidence that FAM171B is present. Following the experiment, we expect to have high quality data concerning where in the body FAM171B is expressed. If, in fact, we do confirm expression in brain tissues, FAM171B could be considered a potential candidate gene for a yet uncharacterized neurodegenerative disease, further advancing the field of cell biology.
Faculty Advisor: Geoffrey Goellner

Poster 47.

Effects of *Marrubium vulgare* on Synergistic Models of Pain in Rats

Riley Menagh
Macalester College

Chronic pain affects a large portion of the population in the United States. Many of the current analgesic medications have undesirable side effects and potential for addiction, creating a need for safer methods of treatment. The objective of this study was to assess the analgesic potential of the traditional medicine *Marrubium vulgare*. Experimental groups of Sprague-dawley rats received a 50 mg/kg dose of a 4:1 extract of Marrubium vulgare followed by a formalin injection and/or hot-plate assay to test the effects of the drug on inflammatory pain and nociceptive pain, respectively. Formalin test and hot-plate assay were used back to back to create a synergistic model of pain in which both inflammation and thermal neuropathic pain contribute to the algesic response (Sycha et. al, 2003). The data demonstrates that Marrubium vulgare has both anti-inflammatory and analgesic properties – subjects having received *Marrubium vulgare* exhibited a decrease in pain behaviors following formalin injection and a longer latency response in the hot-plate assay. The test subjects exhibited no side-effects following consumption of Marrubium vulgare. Further investigation of this plant could lead to novel approaches in the control of pain and suffering in humans.
Faculty Advisor: Eric Wiertelak

Poster 48.

Black Henbane as a Natural Treatment for Pain: Analyzing the Analgesic Properties of Hyoscyamus Niger

Gretchen Greene, Ronald Brisbois & Eric Wiertelak
Macalester College

Chronic pain affects millions of Americans and impacts people's ability to complete daily tasks. This study examined the pain relieving property of the plant black henbane that has served as a treatment for pain in traditional Chinese and Indian medicine. Black henbane is known to contain tropane alkaloids including scopolamine as well as flavonoids, withanolides, lignanamides, and coumarinolignans. Ground seeds from Hyoscyamus niger were successively extracted with hexane and methanol for 24 hours. The concentrated methanolic extract was injected intraperitoneally (i.p.) into six, adult male, sprague dawley rats 30 minutes prior to a hot plate test to evaluate pain response. Two other groups both of six rats were injected with scopolamine (1 mg/kg, i.p.) and saline (0.9%, i.p.) 30 minutes before pain evaluation using the hot plate assay. A one-way ANOVA showed no significant ($p=0.131$) difference between mean latencies of rats treated with black henbane extract, scopolamine, or saline. This study does not support the hypothesis that methanolic extract from black henbane has analgesic characteristics. This study used a low dosage of black henbane, which may be a reason for the absence of an analgesic effect.
Faculty Advisor: Eric Wiertelak

Poster 49.

A Vocal Minority: Ganglion Photoreceptors Exert Widespread Influence Via Gap Junctions

Calisandra Larson, Kellen Mulford & James Demas
St. Olaf College

The existence and quantity of intrinsically photosensitive retinal ganglion cells (ipRGCs) in mammalian retina is well documented in the literature, but not well understood in reptilian retina. Previously, to identify ipRGCs in the common snapping turtle (Chelydra serpentina), we analyzed retinal ganglion cells (RGC) MEA response in a neurotransmitter antagonist cocktail, which blocks rod -and cone-derived input to the RGC layer. In this procedure Gap-junction based input to the RGC layer was ignored. New evidence suggests that gap-junction coupling of RGCs to amacrine cells plays a more significant role in the MEA light response of cells in the RGC. In light of this new evidence, we utilized a gap-junction blocker, Meclofenamic acid (MFA), in our in vitro whole mount recordings and identified putative ipRGCs in snapping turtle retina. To support this finding, we performed immunohistochemical analysis with antibodies that target melanopsin expressing cells. We found melanopsin positive cells in the RGC layer of the snapping turtle retina, and estimated their number to be between 150 to 200 per retina. This number is five to ten times lower than the number found in mammalian retina. In addition to melanopsin expressing cells located in the GCL, we found an example of a melanopsin expressing horizontal cell in the inner nuclear layer (INL) which had previously only been found in fish. Dopamine modulates the light response of ipRGCs through gap-junctions. Dopamine levels are cyclically variable through a 24 hour period. Recordings with D1-like receptor antagonist SCH23390 suggest that high levels of dopamine inhibit the light response of spiking cells in the retinal ganglion cell layer.
Faculty Advisor: James Demas

Poster 50.

Combining Virtual Reality and EEG to Measure Visual Neuroplasticity

Lucius Kelton Wilmerding[1] & Stephen Engel[2]
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Combining traditional EEG systems with Virtual Reality headsets allows researchers to study neuroplasticity – the way experience shapes our brains. Virtual reality and alter the visual environment, while EEG can quantify changes in brain signal. However, combining the two systems is time consuming and uncomfortable. This study designed a prototype Combi-EEG/VR headstrap and used it to measure early visual system responses to two simultaneously presented grating stimuli. The prototype was easier to equip and more comfortable for participants than the old system. Datasets for the pilot study were collected using both the old setup and the prototype, and the signal quality was found to be comparable. To measure the effects of simultaneous contrast presentation, participants wore a combined EEG/VR headset and observed differing contrast gratings either singly or overlaid as a plaid. Vertical gratings were flashed at 4Hz and horizontal gratings were flashed at 15 Hz allowing the resulting Steady State Visually Evoked Potential brain response to be analyzed separately for the vertical and horizontal stimuli. Data collection is ongoing but will hopefully pave the way for further studies using deprivation and adaptation to multiple contrast orientations.
Supported by the NSF. Special thanks to Yihwa Baek, Matthew Johnson and Tay Netoff
Faculty Advisor: Stephen Engel

Poster 51.

Wireless Innervation of Neurons Using Electromagnetic Fields in Crawfish

Benjamin Kuter
Macalester College

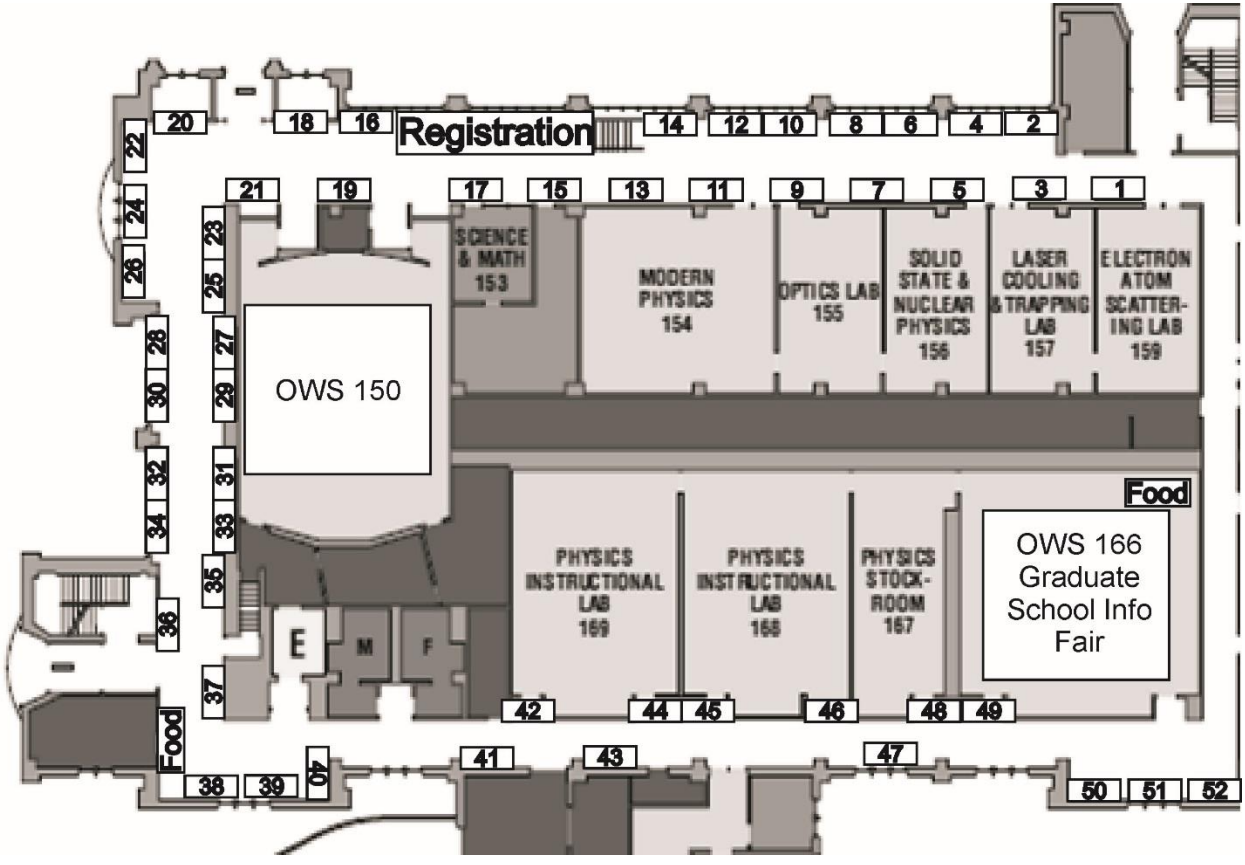
Transcranial magnetic stimulation has been proven to be very effective in treating various post-stroke movement disorders. The fact that these treatment methods indicate some underlying neuronal mechanism that can be modulated by TMS' electromagnetic fields. This was examined by exposing crawfish preparations to varying strengths of EMFs generated by a dual metal-plate array.

The crawfish were prepared by dissecting off their tails, and exposing their superficial flexor. This muscle was then probed with a microelectrode, and placed between the two EMF-generating plates. Signals ranging from 2.0 to 5.0 MHz were tested, in increments of 0.5 MHz with exposure and resting times of 35 seconds.

When the mean difference between each frequency on and off levels were compared, significant differences were detected at every tested level, as measured on a dot plot comparing the mean differences to a null hypothesis of 0.

The results indicated that some neuronal mechanism was being affected by the EMFs. There was an optimal frequency range present in the tested frequencies around 4.5 MHz. Future research should focus on this area. Additionally, any future research should try and fully extract the neuron being recorded in order to study its firing rate instead of resting membrane potential.

Faculty Advisor: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