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List of CSI CRSP students and their abstracts presented at the 2020 Virtual CRSP Symposium

Enhanced Water Collection from Air Using Hybrid-Hydrophobic Surfaces

Edmond George
Mentors: Professors Alan Lyons, Illya Nayshevsky and QianFeng Xu

Water is very essential to life. Harvesting water from the air can supply water for communities in excessively dry environments. Hydrophilic surfaces, which attract water, allow water to condense on the surface in fair amounts. Hydrophobic surfaces, which repel water, allow water to slide off and so be removed from surfaces easily. A combination of a hydrophobic surface with hydrophilic features allows the best utilization of both hydrophobic and hydrophilic properties. This project is aimed at quantifying the amount of water that can be harvested from hybrid hydrophobic-hydrophilic surfaces.
Hydrophobic surfaces were produced and are composed of a fluoropolymer coating on photovoltaic cover glass. Hydrophilic features were produced by mechanically removing the fluoropolymer coating leaving exposed hydrophilic glass. Surface properties were analyzed by measuring water contact angle, water sliding (slip) angle, and contact angle hysteresis (CAH). The water collection properties of the surfaces were analyzed by exposing the surfaces to a controlled humid environment inside a laboratory condensation chamber, and weighing the amount of water that condensed and slid off from surface. Bare (uncoated) glass, and a glass with a continuous hydrophobic coating were used as controls. The amount of water harvested over ~24 hours for each type of surface will be presented.

Effects of Autistic Traits on Acoustic Measures of Vowel Realization

Krissy Dellecave and Alexandra Diaz
Mentor: Professor Jason Bishop

Previous research has shown that some measures of speech production and speech perception vary systematically in relation to autistic traits. For example, speakers with more autistic-like personality traits, as estimated by measures such as the Broad Autism Phenotype Questionnaire, show a decreased use of context in speech perception and complex patterns of vowel-to-consonant interactions in speech production. The present study extends the discussion to differences in vowel production. We test the hypothesis that the acoustic clarity of speakers' vowels is systematically related, in part, to their autistic traits. A large group of native speakers of American English produced words containing four peripheral vowels. Two acoustic measures of vowel dispersion (a measure of acoustic clarity) show that measures of autistic traits predict vowel dispersion in a subset of the speakers. We discuss the implications of the findings for the role of autistic traits in speech and communication.

The Role of Vascular Endothelial Growth Factor in Spinal Cord Injury

Michelle Puma
Mentors: Professors Sreyashi Samaddar and Zaghloul Ahmed

Trans-spinal direct current stimulation (tsDCS) is a neuro-modulatory technique, extensively used to positively effect spinal plasticity and motor function in Spinal Cord injured patients. Spinal cord Injury (SCI) is a condition that affects physiological, psychological, emotional, social, economic, and sexual aspects of a patient's life. Scientists around the globe are working towards deciphering a remedy that might be able to impart a better quality of life to these patients. The objective of this study is to understand the effect of tsDCS on the expression a specific growth factor, vascular endothelial growth factor (VEGF). Through various literature review findings, research studies demonstrate the methodology and significance of VEGF along with tsDCS on motor function recovery. Particularly, how tsDCS regulates the increase of VEGF. Furthermore, Cathodal tsDCS, a stimulation that inhibits neuronal activity, results of overexpression of VEGF in non-injured and injured animals. VEGF, a potent angiogenic factor, also plays a significant role in bone formation, hematopoiesis, wound healing, development, neural migration, and neuroprotection. As a result, increase of VEGF is witnessed in ventral motor neurons. Analyzing this growth factor may help us in developing future therapeutic measures for spinal cord injured patients.

Expression of glucose transporter, Insulin receptor and their role in bioenergetics

Olaya Torres and Kamelea Torres
Mentor: Professor Abdeslem Elidrissi

We have shown that taurine supplementation increased islet size in the pancreas and insulin production by β cells. These changes in pancreatic function are responsible for the increased resistance to glucose challenges in taurine-fed mice. Control mice showed a significant increase in plasma glucose concentration 30 min after glucose injection with a gradual decrease thereafter. By 120min, mice were slightly hypoglycemic relative to baseline. In contrast, taurine-fed mice showed a drastically different response to glucose injection. There was a delayed peak of plasma glucose at 60 min post-injection and the plasma glucose in these mice was significantly lower than controls at all times measured ($p < 0.001$). These data were reproduced in avian. Insulin is primarily a metabolic hormone functioning on muscle, fat, and liver via activation of the IR receptor. Insulin also functions on other non-metabolic tissues such as the brain. Once insulin is secreted it crosses the blood-brain barrier by a transporter-mediated saturable mechanism. The IR is widely expressed in the brain at various levels. This regional specify implicates insulin, through activation of its receptor, in various brain functions that are mediated by these brain structures. In this study, we propose to examine the levels of insulin receptors (IR) expression in the pancreas and brain in controls and taurine-fed pigeons. In mice, we found a significant increase in IR expression in all brain regions and the pancreas compared to controls. Here, we propose to investigate the expression pattern of IR and how it is affected by taurine in the avian model. Interestingly, changes in the expression levels of insulin receptors were associated with changes in the expression levels of glucose transporter (Glut 4) in neurons. We suggest that circulating levels of insulin regulate the expression levels of insulin receptors in the brain that in turn regulate neuronal bioenergetics through regulation of the expression of Glut4.

Are microplastics a problem in beach sediments? A pilot study of Lemon Creek Beach, Staten Island

Ting Ting Chen
Mentor: Professor Jane Alexander

Microplastics are small pieces of plastic that are less than 5mm in diameter. These plastic particles originated from plastic packaging materials such as plastic bottles, plastic bags, personal care products, and fishing lines and nets. These small pieces of plastics that are washed into the sea have had a great impact on marine life because many of these microplastics are consumed by marine organisms and work their way up the food chain. We consume fish and other marine organisms, which means we are consuming the microplastics too. This project assesses the impacts of this global issue at a local level by determining how much microplastic is present at Lemon Creek Beach, Staten Island, and describing shapes and colors of the fragments. Samples were collected from the top 5 cm of the beach sand at the high tide line using a sediment corer. We then took back the samples we collected from the beach to the lab and dried the sediments to prepare for sieving. Samples were sieved for 15 minutes to split them into 4 size fractions (< 300 µm, 300 µm – 1 mm, 1 – 5 mm and everything > 5 mm). Many samples contained organic matter, so we removed it using hydrogen peroxide. We separated the microplastics from the beach sediment by performing a density separation using a saturated NaCl solution. The microplastics float and the sediments sink, with the smaller size fractions needing a longer settling time than the larger ones. We then vacuumed the supernatant and filtered it to collect any floating material on the filter. We examined the filters for microplastic particles using a binocular microscope. The microplastic particles collected will be counted, photographed and described, to determine the extent of the problem at Lemon Creek Beach.

Electrophysiological and biochemical characterization of neuronal excitability in fragile X mice

Reem Gouda
Mentor: Professor Abdeslem El Idrissi

In this study, we examined the fragile x mouse model, fmr1 KO mouse to characterize the excitability of neuronal circuits using the stretch reflex as a model. The FMR1 KO exhibited an enhanced stretch reflex response characterized by an increase in both muscle tension and electromyogram amplitude. The enhanced stretch response was mediated both at the level of CNS and muscle. FMR1 KO mice showed enhanced muscle tension under isoflurane anesthetic. At the level of the muscle, we found histological alterations characterized by changes in the distribution of connective tissue and diameter size of muscle fibers. Furthermore, FMR1 KO muscle displayed ultrastructural modification characterized by longer and thinner sarcomeres. These histological alterations in myofibril and extracellular components of the muscle could explain the exaggerated response of the stretch reflex that is due to the passive properties of the muscle. Immunofluorescence of the spinal cord showed enhanced immunoreactivity in both glutamic acid decarboxylase and choline acetyltransferase and a decreased expression of both GABAA and glycine receptor in the taurine deficient mice compared to controls. Disruptions of the cholinergic, GABAergic and glycinergic systems in the spinal cord may be contributing to the enhance reflex due to changes in excitability and inhibitory functioning. In this study, we propose to further characterize neuronal excitability in fmr1 mice by looking at neurotransmitter receptor expression in the brain and the functional consequences of altered expression of these receptors by measuring neuronal excitability electrophysiologically.

Applications of Singlet Oxygen in Photodynamic Therapy: Evaluating the stability of Chlorin e6

Anastasia Maximenko
Mentors: Professors Alan Lyons and QianFeng Xu
Live Presentation Award Winner

Photodynamic Therapy (PDT) uses light, a photo-sensitizer, and molecular oxygen to form an excited state of oxygen, known as singlet oxygen to cause cell death and kill microbial cells. PDT is a minimally invasive technique because the lifetime of the excited state is less than 10 microseconds before it decays back to the molecular oxygen ground state. However, it can be used to treat various malignant cancers, macular degeneration, psoriasis, actinic keratosis, and periodontal disease. Chlorin e6, a hydrophobic photo-sensitizer (PS), can be derived from algae and is used in several countries for PDT; it was selected for this project because of its low cost and high efficiency in the generation of singlet oxygen. The purpose of this study is to evaluate the stability of chlorin e6 when exposed to the excitation wavelength. The study will use a high intensity LED (Cree Semiconductors, peak output at 664 nm) to irradiate the sample and UV-vis absorption spectroscopy to analyze the absorption maxima of the molecule that occur at 405 nm and 658 nm. A series of concentrations of chlorine e6 in aqueous PBS buffer solution will be studied as a function of irradiation time. A Beer's Law calibration plot was used to quantify the concentration of chlorin e6 in solution. The degradation of chlorin e6 vs time and the decomposition rates in the dark vs during exposure to the red LED will be presented.

Late Onset Ataxia in the Fragile X Mouse

Mustapha Kobeyssi
Mentor: Professor Abdeslem El Idrissi

Fragile X syndrome is a genetic condition that is due to a trinucleotide CGG expansion in the premutation alleles along the promotor region of the FMR1 gene. Fragile X associated Tremor/ ataxia syndrome, which is caused by these triplet expansions, is considered a neurodegenerative disorder affecting males with late onset (ages > 50 yrs). FMRP is an mRNA binding protein and has been shown to play a role as a transporter of mRNA. Therefore, the absence of FMRP causes improper shuttling of mRNA which leads to abnormal brain development.

In this study, we examined histogenesis and pattern of connectivity of the principle cells of the cerebellum; Purkinje cells. The importance of Purkinje cells in the cerebellum is due to their ability to act as a resistance modulator during a high volume of incoming signals from proprioceptors, basal ganglia and other areas of the brain. Thus, alteration in synaptic connectivity of Purkinje cells with other cells of the cerebellum will lead to alteration in motor movement and Ataxia-like symptom.

Since ataxia is a neurodegenerative disorder characterized by abnormal locomotor activity, we hypothesize that abnormal synaptic connectivity in cerebral and cerebellar structures in the fmr1 Ko mice brains may lead to late onset ataxia and other cognitive deficits in these mice.

We found that fmr1 Ko mice, like human with fragile X syndrome show late onset ataxia. Ataxia in fmr1 Ko mice was evaluated using DigiGait equipment which quantifies forelimb and hindlimb coordination as the mice walk on a treadmill. Synaptic connectivity was measured electrophysiological from the brain of fmr1 Ko mice as an indication of the pattern of neuronal firing. Finally, we evaluated histogenesis of the cerebellum by examining the arborization of the dendritic tree of Purkinje cell using immunohistochemistry and biochemical markers of Purkinje cells.

In conclusion, we found that fmr1 Ko mice demonstrate altered electrophysiological, biochemical and histological properties that we suggest are responsible for the later onset ataxia observe in these mice. These alterations are mediated by the transcriptional dysregulation due to the lack FMRP.

Testing the Thermal Stability by Using Singlet Oxygen

Mehnoor Khan, Danielle Ohana, and Samuel Krichavets
Mentors: Professors Alan Lyons and QianFeng Xu

Singlet oxygen (1O2) is an excited state of oxygen, which has real world applications. One of the benefits of singlet oxygen is its ability to kill bacteria. Currently, it is being studied by dental professionals to eradicate bacteria that is linked to periodontal diseases. The existing approach uses a sensitizer that is directly applied to the periodontal pocket and limits the delivery span to about 3 mm. This is a concern, as some pocket depths reach 8-10 mm. The advancement of a device with the capability to deliver highly localized singlet oxygen at these depths would be a major improvement over current periodontitis treatments.
Singlet oxygen is produced when a laser diode emits light at a wavelength of 664 nm onto a superhydrophobic sample that is coated with a photosensitizer. This illuminates the sensitizer particles that then react with proximate oxygen gas. In this study, the thermal stability and photostability of samples were tested. The sample used is coated with a solution of Chlorin e6 (Ce6) dissolved in dimethyl sulfoxide (DMSO). Thermal stability was tested by heating the sample at 60°C for varying times, as well as testing a control group, which was not exposed to any heat. Photostability was tested by photobleaching the samples, which entails placing a sample in an empty cuvette and exposing it to an LED light for 30 minutes. After exposing the samples to these accelerated conditions, they were placed in a uric acid trapping solution to quantify the amount of singlet oxygen generated by the surface. Rates were determined using UV- Vis spectroscopy. Preliminary results are reported.

TGFb Pathway Gene Expression Patterns in Non-small cell lung carcinoma and in Glioblastoma Multiforme

Briana Soto
Mentor: Professor Nancy LiuSullivan

Glioblastoma multiforme, GBM, is categorized as the most aggressive form of glioma found along the central nervous system. While gliomas approximately make up 80% of all malignant brain tumors, GBM is responsible for approximately half of all primary brain and CNS cancers. This form of cancer targets more men than women and increases in tumor frequency with age as well. Once diagnosed, patients will typically receive a poor medical prognosis with an average survival rate of 12 to 18 months. Invasive ductal carcinoma, IDC, is one of the most common forms of breast cancer diagnosed in women. Non-small cell lung cancer, NSCLC, is one of the most common types of lung cancer. It arises from the epithelial cells in the lung of the central bronchi and to the terminal alveoli. The most common cause of NSCLC is attributed to smoking, but the cancer can also be found in individuals who have no history of smoking. NSCLC will be diagnosed in approximately, 80-85% of all diagnosed lung cancers, rendering it a fairly common lung cancer type. At stage IV, NSCLC will become difficult to treat by standard cancer treatments. The gene expression patterns of both cancers will be studied. According to the pattern of the gene expression, the studies will help to determine which set of gene can potentially be used in order to develop novel drug treatments. Over expressed genes would become the ideal candidate for such treatment.

The Structure, Meaning and Pronunciation of What-Marked Yes/No Questions in New York City English

Karen Correa
Mentor: Professor Jason Bishop

In this study we examine what we refer to as What-marked Yes/No questions (WH-YN) in the New York City variety of English. Examples of WH-YNs are shown in (1) and (2):
(1) What am I? Chopped liver?
(2) What are we? George Washington?
It is clear that WH-YNs are not genuine questions; rather than genuine requests for information, they are rhetorical, which is readily seen when comparing (1) and (2) with the genuine WH-questions in (3) and (4), respectively:
(3) What am I?
(4) What are we?
In the present study, we outline results of an analysis of WH-YNs based on a corpus of popular media. We describe how WH-YNs are distinct from standard WH-questions not only in terms of meaning, but also their syntactic structure, use, and pronunciation.

Interaction of Different Tau Mutations In Vitro

Marven Fam and Momtahina Akter
Mentors: Professors Alejandra Alonso and Viktoriya Morozova

Tau is a microtubule-associated protein (MAP). Tau is required because it assists in sustaining the microtubules in the neural axons in the CNS. Tau is a phosphoprotein and the degree of phosphorylation is important for the normal functions of tau. When tau is hyperphosphorylated, it can't bind to tubulin and stabilize the microtubules. Furthermore, abnormal and hyperphosphorylated tau binds to normal tau and segregates it from the microtubules. Thus, it results in a microtubule disruption and death of the neuron. Normally, tau contains 3 moles of phosphate per mole of protein. However, in an Alzheimer's disease patient, tau protein gets hyperphosphorylated, which results in containing 7-10 moles of phosphate per mole of protein. Previously we had shown that hyperphosphorylation of tau at Ser 199, Thr 212, Thr 231, and Ser 262 with R406W mutation is sufficient to induce pathological conformation of tau similar to one found in Alzheimer's Disease patients. Alzheimer's disease is a progressive disease that contains numerous manifestations, such as destroying the memories of an individual and other neurological functions.
This research was developed to examine the interactions between various tau mutations. For this specific project we want to tag four tau protein constructs with red fluorescent tag (DsRed). There are four tau construct, such as wild type (wt), tau hyperphosphorylated at Ser 199, Thr 212, Thr 231, and Ser 262 (P-Tau); tau with R406W mutation (R406W) and tau pseudo-phosphorylated at Ser 199, Thr 212, Thr 231, and Ser 262 with R406W mutation (PH-Tau) tagged with green fluorescent protein (GFP). To accomplish our objective we want to cut tau genes out of vectors containing GFP and insert them into the vectors containing DsRed. The successful execution of tau constructs tagged with DsRed will allow us to observe the interactions between two different tau mutants.

Selective Attention and Emotion Recognition in College Students Assessed with the AQ and RAADS-14

Arouje Shaikh

Mentor: Professor Bertram O. Ploog

Emotion and facial recognition are crucial aspects of social interaction. The ability to comprehend one's facial features related to emotions is a crucial social skill that allows people to communicate upon a deeper meaning. The current research topic is the ability of individuals with ASD to accurately recognize emotions in facial expressions. Many individuals with ASD are known to have deficits in emotion recognition but these deficits are still only poorly understood. In the present study, a pre- and post-test and a training phase were implemented to show the effect of training on attention to compound stimuli, especially photos of emotional facial expression. Participants were expected to show longer response times with emotional stimuli than with non-emotional stimuli because of the increased complexity of emotional stimuli. It was further expected that participants who score low (i.e., less "autistic") on the AQ and RAADS-14 would be more accurate in responding to all stimuli than participants who score high especially with the emotional stimuli. Finally, we hope that this discrepancy is reduced (with evidence in the post-tests) due to training. These results are important because they suggest an effective intervention to increase emotion recognition in individuals with ASD with the subsequent improvements in social skills.

A Research Game that Models Collaboration between Autistic Players

Konstantin Novichenko
Mentor: Professor Deborah Sturm

Pre-recorded Presentation Award Winner

We extended a two-player research game that is designed to study the collaborative and emotion recognition abilities of players on the autism spectrum. The video game has 2 phases – first, the players independently assemble a digital puzzle using gestures. Then players communicate in-person to agree on the appropriate emotion for the context. Animations before each scene communicate the context (for example bullying). The players collaboratively select the appropriate emotion of the protagonist (for example sadness). We expected that when an expert player models behavior, a novice player will learn game mechanics and will communicate more as the game progresses. Preliminary observations show that modeling of game play by peers with stronger social skills is effective in improving collaboration. Each testing session consisted of five levels. During the first three levels, the modeler used exaggerated gestures and initiated a discussion about the appropriate emotion to select. After the first three levels until the end of the game session, the modeler stopped exaggerating gestures and didn't initiate a conversation to observe whether the novice player would model initiating collaboration. We conducted a series of sessions with 14 typically developing players and 7 players on the autism spectrum. Six out of 14 of the typically developing participants and 5 out of 7 of the participants on the autism spectrum stated that expert peer modeling improved their understanding of gameplay and helped them to communicate and collaborate more. Moreover, after analyzing video sessions, we concluded that 8 out of 14 of the typically developing participants and 6 out of 7 of the participants on the autism spectrum adopted the modeled behavior and initiated conversations.

Are microplastics a problem in beach sediments? A continuing study of South Beach, Staten Island

Alex Fiero
Mentor: Professor Jane Alexander

Microplastics are small pieces of plastic that pollute the environment. To be defined as a micro plastic they must be a particle smaller than 5mm. They can be manufactured this size or formed from the breakdown of larger plastics, so their shape and color vary. Microbeads and nurdles are example of manufactured microplastics and are often improperly disposed of and end up in our oceans. Microfibers are thread like fibers that tend to come off synthetic clothes, the shedding of plastic microfibers can occur just from washing clothes and potentially be dispersed into the environment. There is concern for marine life considering microplastic is a harmful pollutant and potentially be toxic when ingested. This is a potential hazard for humans as well, since it is contaminating our commercial fish groups that are eaten regularly. The purpose of this research is to determine the quantity and nature of the microplastics in sand samples that were collected along South Beach. Our samples were separated based on grain size to measure the concentration of microplastic found at each size, so each sample was separated into three different size groups, 1-5mm, 300 µm -1mm and <300 µm. A density separation is performed on each sample, but in earlier separations, organic matter would be collected along with the suspected microplastic particles. To prevent this from happening in later separations we started treating each of the fine subsamples with hydrogen peroxide to dissolve any organic material that may have been mistaken for a plastic. The density separation was performed using a NaCl saturated solution, the solution was mixed with a sample and allowed to rest, sediment sank to the bottom of the beaker and any plastic particle was suspended on top of the solution. The top of the solution is then vacuumed, isolated and filtered through a glass fiber filter. Any microplastic particles are collected on the filter disk and are noted based on what subset they came from. In several filters you will see noticeable microplastics, such as clusters of fibers that are black and silver as well as a few clear plastic particles in one sample, and a few plastic fibers which are silver or opaque and a small red fiber in another. For microfibers their color has been mostly silver and clear but there are various colors in our collection such as red, blue, and black and for microfiber beads their colors are light brown to opaque, their shapes vary from smooth pearls to fragmented textured chunks. Further samples are currently being processed and should allow for an analysis of any variations in geographical distribution along the beach.