



Research Scholars Program

List of CSI CRSP students and their abstracts presented at the 2021 Virtual CRSP Symposium

Investigating Gene Expression Patterns of IL-6 and p53 Signaling Pathways in Metastatic Breast Cancer (MBC)

Lara Anastasia Colombo

Mentor: Professor Nancy Liu-Sullivan

Despite all the progress made, cancer remains a challenging disease. Aggressive cancer type, Metastatic Breast Cancer (MBC) is particularly difficult in terms of treatment. This form of breast cancer takes the lives of 40,000 people annually. Since the immune system plays an essential role in cancer development, interleukin-6 (IL-6) is an essential molecule that controls multiple aspects of human immunity in the immune system. Examining gene expression pathways in the immune system is vital for establishing potential treatment methods. Identifying notable deviations in expression of various signaling components that fall on the IL-6 signaling pathway and adjacent pathways, in particular, p53 signaling pathway is a core focus for this study. The action of monitoring over and under expression of genes is imperative for discovering possible complications associated with the diagnosis of breast cancer. Based on statistical data gathered from numerous studies, the indicated overexpression of components IL6R Alpha and GP 130 could lead to damage to the system. Overexpression of genes can correlate to significant tissue damage as well as other severe consequences of breast cancer. Findings of underexpression in components such as c-Myc, p53, MDM2, IL-6, STAT3, and JAK are deduced from the reduction of the medians of the normal tissue control to the invasive cancerous tissue. The aforementioned components are found on IL-6 signaling pathway as well as from a neighboring p53 signaling pathway cross talk with one another which means there are shared overlapping signals between said signaling components. As a follow-up study, we plan on exploring additional genes known to crosstalk with IL-6 in Metastatic Breast Cancer.

The Structure, Meaning, and Prosody of WH-Marked Yes/No Questions

Karen Correa

Mentor: Professor Jason Bishop

Presentation Award Winner

This study is part of an ongoing investigation into a construction that we call WH-marked Yes/No questions (WHYN). WHYNs are found characteristically, though perhaps not exclusively, in the New York City variety of English (NYC English). An example of a WHYN is shown in (1):

(1) What am I? George Washington?

Previously, we have established the following about this construction. First, it is clear that WHYNs are not genuine questions, they are rhetorical rather than actual requests for information. Second, they

seem to imply that the speaker believes that the hearer believes the answer to be “yes” (even if the speaker understands the question to be “no”). Third, although a common use of these questions includes a sarcastic connotation, sarcasm is not a central part of their meaning. In this presentation, we concentrate on their pronunciation, which seems to involve special prosody (i.e., rhythm and melody characteristics). WHYNs appear to be marked by early sentential stress on the WH-word, distinguishing them from standard WH-questions (information-seeking questions), or any other kind of question in American English. Our discussion will focus primarily on these stress patterns, and on the WH-element rather than the Y/N-element, testing whether the observation just described holds in a corpus of NYC English taken from the popular television sitcom Seinfeld., we plan on exploring additional genes known to crosstalk with IL-6 in Metastatic Breast Cancer.

Do neurotypical autistic traits predict vowel production? Evidence for sex-based differences

Alexandra Diaz, Maha Elcharfa & Krissy Dellecave

Mentor: Professor Jason Bishop

Previous research has shown that measures of speech production and speech perception vary systematically in relation to autistic traits, i.e., characteristics of the ‘broad autism phenotype’ that exist in the healthy neurotypical population. In the present study we investigate the role that autistic traits play in speech production in communicative contexts. More specifically, we test whether autistic traits related to pragmatic communication predict acoustic measures of vowel intelligibility in a large group of neurotypical native English-speaking adults. Results of acoustic analysis of the vowels $\{i, \epsilon, \alpha, u\}$ show that autistic traits, as measured by the pragmatic communication subscale of the Broad Autism Phenotype Questionnaire (Hurley et al. 2007), are inversely associated with acoustic correlates of vowel distinctiveness (vowel space area and vowel dispersion), indicating that speakers with higher autistic trait load produce less clear, less intelligible vowel categories. However, this effect is found only in female speakers. We discuss the implications of this finding for our understanding of the role that sex/gender play in speech production, and in defining the language-related differences that characterize speech in autism.

Push and Pull factors leading migrants to South Africa

Gregory Fazio

Mentors: Professors Jean Halley and Ron Nerio

South Africa is the primary destination for transnational migrants within Sub-Saharan Africa. In 2017 South Africa had approximately 4 million migrants living within its borders (1). Transnational migrants are often forced to leave their countries of origin to take the precarious journey to South Africa. The drivers of this movement include poverty, unemployment, political violence, water scarcity, and weather crises. People are attracted to South Africa because it is the most industrially and economically developed country in Africa and is viewed as a land of opportunity. Migrants can sometimes improve their own economic situations and support their families back home through the remittance of cash and goods. Approximately US\$2 billion are sent every year from South Africa to other Sub-Saharan African countries (3). As more and more people leave rural areas due to drought and technological change, experts predict a continued flow of migrants into South Africa for the foreseeable future. In this literature review I examine the push and pull factors driving this mass migration. In particular I focus on the reasons people are leaving Angola, the Democratic Republic of Congo, Malawi, Ethiopia, Mozambique, Nigeria, the Republic of Congo, Zimbabwe, and Zambia (push

factors) and why they are going to South Africa (pull factors). Some of the push factors are the same among all of these countries and in some cases the push factors are unique to specific countries.

The Expression and Role of Glucose Transporter and Insulin Receptor in Bioenergetics

Reem Gouda

Mentor: Professor Abdeslem Elidrissi

Presentation Award Winner

It was observed that taurine supplementation increased islet size in the pancreas and insulin production by β cells. These changes in pancreatic function are responsible for increased resistance to the 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 Insulin receptor (IR). 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 specificity 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 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. Interestingly, changes in expression levels of insulin receptors were associated with changes in the expression levels of glucose transporter in neurons.

The Application of Photodynamic Therapy Utilizing Singlet Oxygen in the Sterilization Process for Root Canals

Mehnoor Khan

Mentor: Professor Alan Lyons

Every year there are approximately 15 million root canals performed in America. A root canal is a procedure that eliminates bacteria from an infected tooth by removing the inflamed or infected pulp. After the procedure is done, the tooth is cleaned, disinfected, and sealed. Root canals, have numerous bacteria's in the canals but *Enterococcus (E.) faecalis* is the most detrimental because it can be resistant to antibiotics agents. The current method to disinfect/sterilize a root canal procedure uses aqueous sodium hypochlorite, known as bleach. Sodium hypochlorite is affordable but has severe complications when it comes into contact with soft tissue. Furthermore, it is toxic, and can discolor teeth. A technique that would be safer and more consistent in eradicating bacteria in the canal is needed. Currently, Photodynamic Therapy is the most promising alternative.

Photodynamic Therapy utilizes visible light, a photosensitizer, and molecular oxygen to produce an excited state of oxygen called singlet oxygen and other reactive oxygen species (ROS). Singlet oxygen can kill bacteria either when the photosensitizer has diffused inside the bacteria or when it is located outside of the bacteria. When the photosensitizer absorbs light it can transfer the energy to oxygen to generate (ROS) which disrupt either internal bacteria functions or the cell membrane. In this poster

I will describe Photodynamic Therapy techniques in detail and summarize results from in-vivo trials by studying the different photosensitizers and methods utilized.

Healthcare and Education Barriers for Transnational Migrants in South Africa

Angelica Lisiewski

Mentors: Professors Jean Halley and Ron Nerio

South Africa has the largest population of transnational migrants in Africa, with about four million people having crossed at least one border to reach the country. Such migrants travel long distances in search of safety, better economic opportunities, and the chance to send money to their families back home. A poorly functioning asylum system, however, creates serious obstacles to a stable and secure life. This literature review focuses in particular on barriers to healthcare and education for several categories of migrants: formal refugees, asylum seekers, undocumented migrants, and unaccompanied minors. The data comes from scholarly articles and NGO reports, published between 2006 and 2020, that focus on migration within and to Southern Africa. Though transnational migrants enter South Africa hoping for better living conditions, the literature shows that they are often denied access to healthcare, frequently face significant disadvantages in educational settings, and are regularly harassed by the police. Migrant youth are particularly disadvantaged in terms of accessing education because their parents often face difficulties enrolling them in educational programs; therefore, they miss several years of school. Many organizations work with migrants to help them overcome these obstacles.

Applications of Photodynamic therapy in wound and burn healing: a literature review

Anastasia Maximenko

Mentor: Professor Alan Lyons

Burns are a global public health issue because wound infections are a common complication that delay, or prevent, healing. Reductions in overall wound-infection rates will be beneficial to patient outcomes and reduce overall costs. Inevitably, all wounds will be colonized by some bacteria. However, *Staphylococcus aureus* bacteria accounts for the majority of wound infections. Outbreaks of various multidrug-resistant (MDR) bacterial strains happen at an alarming rate, and physicians and patients are in need of alternative treatment options. It has been suggested that the use of topical antibiotics induce antibiotic resistance faster compared to oral antibiotics. This review assesses an alternative treatment, photodynamic therapy (PDT), for the treatment of burn and wound infections. 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 offers multiple advantages over antibiotics and UV therapy. In particular, PDT shows broad antibacterial activity, offers rapid action, localized treatment, lower risk of systemic side effects, and leads to effective inactivation of bacteria regardless of drug resistance. However, there are some challenges pertaining to the use of PDT, such as imperfect selectivity for bacteria over proteins and cells. Currently, it has not been demonstrated if bacteria can develop resistance to PDT. Efflux pump inhibitors could be used in conjunction with PDT to enhance its therapeutic effects against infections. Our future studies will focus on the efflux pump mechanism of action to better understand the possibilities of bacterial resistance. In this literature review, I will discuss the applications of PDT in burns and wounds; assess the level of bacterial inactivation; summarize recent clinical trials and consider possible uses of PDT to treat other dermatological conditions.

Comparison of E+A's Galaxies Within the Coma Cluster

Sam Pakravan

Mentor: Professor Charles Liu

Studying the aging processes of galaxies helps us understand the history of the universe around us, including our own Milky Way galaxy. E+A galaxies are known for having spectra of an early-type ("E") galaxy, typically many billions of years old, together with strong hydrogen Balmer absorption lines that are produced in the photospheres of stars that are only about 1 billion years old (type "A"). That means E+A galaxies are a special type of "post-starburst" galaxies, in which star formation had been going at a high rate but then shut down approximately 1 billion years ago. When a galaxy enters a post-starburst phase, O and B type stars (which are the brightest and most short-lived) die off, and about a billion years later leave A type stars to be the brightest in the galaxy. The goal of this project is to compare different E+A galaxies in the rich cluster of galaxies known as Coma Berenices. In our previous work we found that among 179 celestial objects in the cluster, 2 galaxies were E+A candidates while 4 other galaxies would be E+A candidates with the exception of their strong emission lines. We anticipate studying more than one thousand objects in and around the Coma cluster by the end of this summer. Accordingly, we will be able to identify many more E+A galaxies in the region. By comparing galaxy's spectral features, redshift and magnitudes it will be possible to better understand how these rare galaxies evolve after their star formation has ended. By the end of this project these galaxies will help us be able to better understand the galaxy evolution of E+A galaxies and the evolution of the Coma cluster within the past few billion years.

The Lives and Rights of Transnational Migrants in Johannesburg, South Africa

Leo Bernabei, in collaboration with Angelica Lisiewski and Greg Fazio

Mentors: Professors Jean Halley and Ron Nerio

Presentation Award Winners

At 272 million, the number of transnational migrants today is greater than it has ever been. We focus on a specific subset of migrants: those residing in Johannesburg, South Africa. Studying migration to South Africa presents a unique scenario for several reasons. Namely, South Africa is widely recognized to have one of the most progressive constitutions in the world. However, both anecdotal and statistical evidence suggest that South African authorities do not always provide asylum-seekers and refugees with the full protections to which they are entitled by international and national law. Additionally, South Africa receives asylum seekers and other migrants from across the African continent. This study reviews the literature pertaining to the lives and rights of migrants published since the democratic constitution was ratified in 1997. This review, along with targeted interviews with migrant-serving institutions in Johannesburg, reveals that South African authorities routinely disregard the rights guaranteed by the Constitution. Furthermore, xenophobia in many forms complicates the lives of non-nationals trying to survive in South Africa.