McNair Scholars Journal

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GRAND VALLEY STATE UNIVERSITY

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Message from Robert P. Smart

Vice Provost for Research Administration and
Executive Director of the Center for Scholarly and Creative Excellence

It gives us great pleasure to present the 2013 Grand Valley State University McNair Scholars Journal. It is the culmination of the collaborative explorations conducted by our student scholars and their faculty mentors through our Ronald E. McNair Scholars Program. Their contributions to this journal represent the persistence and creativity of our students and the faculty mentors who exemplify the dedication of our campus to undergraduate success.

The Ronald E. McNair Scholars Program, now in its 20th year at Grand Valley State University, is a federally-funded program geared to provide research opportunities for low-income/first-generation, and underrepresented college undergraduates to better prepare them for graduate school. At GVSU, our strategic goals and values align with the McNair Scholars Program as we strive to improve both the diversity and quality of our students and prepare them for success beyond their undergraduate experience.

We would like to congratulate each of the McNair Scholars whose research is presented here. We would like to thank the faculty mentors who have worked so closely with our McNair Scholars to propel their intellectual curiosity and foster their goals and dreams. I would also like to extend my appreciation to the staff of the McNair Scholars Program; it is their dedication and hard work that help make these successes possible.
We hope you enjoy learning about the great work done by our students and their faculty mentors.

Sincerely,

Robert P. Smart Ph.D.
Vice Provost for Research Administration and
Executice Director of the Center for Scholarly and Creative Excellence

GRAND VALLEY
STATE UNIVERSITY

"Before you can make a dream come true, you must first have one." – *Ronald E. McNair, Ph.D.*

Ronald Erwin McNair was born October 21, 1950, in Lake City, South Carolina, to Carl and Pearl McNair. He attended North Carolina A&T State University where he graduated Magna Cum Laude with a B.S. degree in physics in 1971. McNair then enrolled in the prestigious Massachusetts Institute of Technology. In 1976, at the age of 26, he earned his Ph.D. in physics.

McNair soon became a recognized expert in laser physics while working as a staff physicist with Hughes Research Laboratory. He was selected by NASA for the space shuttle program in 1978 and was a mission specialist aboard the 1984 flight of the USS Challenger space shuttle.

After his death in the USS Challenger space shuttle accident in January 1986, members of Congress provided funding for the Ronald E. McNair Post-baccalaureate Achievement Program. The goal is to encourage low-income, first generation students, as well as students who are traditionally underrepresented in graduate schools, to expand their opportunities by pursuing graduate studies.

Ronald E. McNair, Ph.D.

Ronald E. McNair Post-baccalaureate Achievement Program

The Purpose
The McNair Scholars Program is designed to prepare highly talented undergraduates to pursue doctoral degrees and to increase the number of individuals (from the target groups) on college and university faculties.

Who are McNair Scholars?
The McNair Scholars are highly talented undergraduate students who are from families with no previous college graduate, low-income background or groups underrepresented at the graduate level for doctoral studies. The program accepts students from all disciplines.

Program Services
The McNair Scholars are matched with faculty research mentors. They receive academic counseling, mentoring, advising, and GRE preparation. In addition to the above services, the McNair Scholars have opportunities to attend research seminars, conduct research, and present their finding orally or written via poster presentations. In the first semester of their senior year, the scholars receive assistance with the graduate school application process.

Funding
The Ronald E. McNair Post-baccalaureate Achievement Program is a TRiO Program funded through the United States Department of Education and Grand Valley State University.

Novel Antimicrobials to Combat Gram Positive Bacteria

Alexandra Bouza
McNair Scholar

Robert Smart, Ph.D.
Faculty Mentor

A novel class of antibacterial substances has been discovered in a collaborative project between the Chemistry and Biology Departments at Grand Valley State University (GVSU). These compounds do not rely on currently accepted antibiotic chemical structure, but seemingly have a mechanism of action different from understood mechanistic pathways for treatment of infections and are readily synthesized, avoiding complex, stereoselective, multi-step synthesis.

This new class of antibiotics is composed of chemical derivatives of the telomerase inhibitor BIBR1532 [US Patent 6362210]. Our compounds demonstrated *significant antimicrobial activity* against a group of Gram-Positive microorganisms. The antibiotic's minimum inhibitory concentrations (MICs) against these bacteria are equivalent to existing antibiotics (2-78 ug/ml). In subsequent *in-vitro* tests these compounds showed activity against methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin resistant enterococci (VRE), *Bacillus anthracis* (anthrax), and *Clostridium difficile* (Cdiff). The antibacterial activity against MRSA, VRE, and Cdiff strains of bacteria is promising as it demonstrates the ability of BIBR 1532 to inhibit microbial growth in organisms with resistance to common antibiotics.

In 2008, GVSU patented this antibiotic family. Since then, we determined that the frequency of bacterial resistance to this class of antibiotics is extremely low. Over 70 compounds were tested for antibacterial activity. Sixty demonstrated antibacterial activity and of these 18 were more thoroughly tested against 25 bacterial and fungal strains. We discovered that a number of compounds had low minimum inhibitory concentrations (MICs) against *Staphylococcus aureus* (including MRSA strains), *Bacillus anthracis* (anthrax), *Clostridium difficile*, and *Streptococcus pneumonia*. These results were encouraging as they demonstrate multiple bacterial targets with low drug concentrations (2-8 ug/ml).

Additionally, we tested six compounds in acute *in vitro* toxicity screening in a rat hepatoma (H4IIE) cell line at 24 hour exposure. All compounds demonstrated minimal toxicity to the cell line. These toxicity results demonstrate that potential negative side-effects to patients appear to be minimal.

Further testing of our antibiotics revealed significant binding to human serum protein. This is potentially problematic in clinical use as there is less available compound in the blood. There are conflicting opinions as to the significance of binding to serum protein. For example, nine of the top 10 best-selling small molecule, single agent prescription drugs of 2006 had 90% or greater binding to serum protein and seven of the top ten had 95% or greater [Rydzewski, R.M., 2008]. A potential problem exists and we continue to work towards lowering this binding to increase potential available drug concentrations in the blood.

The Role of Post-Translational Modification of Rfg1 in the Regulation of Candida albicans Filamentation

Nico Fernandez
McNair Scholar

Derek Thomas, Ph.D.
Faculty Mentor

Candida albicans is a fungal commensal that resides in the mucosal tissues of approximately 30-70% of the population. Infections in the otherwise healthy individual are rare; however, infection rates can increase for those with certain risk factors such as invasive surgery or compromised immune systems. Systemic candidiasis is a systemic infection with *C. albicans* and is the fourth most frequent nosocomial infection in the US. The ability to reversibly switch its morphology between yeast cells, pseudohyphae, and true hyphae is integral to the pathogenic potential of *C. albicans*, playing key roles in biofilm formation and pathogenicity. This research focuses on Rfg1, a negative regulator of the filamentation process. Rfg1 is believed to function in conjunction with Tup1 to repress genes associated with filamentation; however, the exact mechanism of interaction between the two proteins is unknown. Our current understanding is mostly extrapolated from the model yeast organism *Saccharomyces cerevisiae*, but there is restricted homology between Rfg1 (65kDa) and the *S. cerevisiae* equivalent, Rox1 (40kDa). Of the 1.8 kb sequence of Rfg1, 100 bp in the HMG DNA binding domain shares 52% identity with Rox1 and there is little similarity outside the HMG domain. Past research has shown that a S. cerevisiae strain missing both alleles for Rox1 (*Δrox1/Δrox1*) shows increased sensitivity to caffeine, a purine analog with deleterious effects. Thus, caffeine sensitivity was assayed in a homozygous null *Δrfg1/Δrfg1 C. albicans strain*, resulting in no visible change in sensitivity. This data supports the functional disparity between CaRfg1 and ScRox despite their shared similarity. Recent data from our lab has implicated post-translational modification in the control of the interactions between Tup1 and its co-repressors. *In silico* analysis of Rfg1 with the web-based phosphorylation software NetPhos 2.0 showed multiple amino acid residues in the primary sequence of Rfg1 have the potential to be phosphorylated. Phosphorylation is a form of post-translational modification which can drastically alter the function of a protein. In the case of Rfg1, phosphorylation could have many effects. It could facilitate the dissociation between Rfg1 and Tup1, causing Rfg1 delocalization to the cytoplasm. Conversely, it could localize Rfg1 and increase its affinity for Tup1. Our future work will begin to analyze variations in post-translational modifications of Rfg1 and interactions with other co-repressors during different filamentation inducing conditions through affinity purification of a polyhistidine - Rfg1 fusion protein, tandem mass spectrometry and protein crosslinking assays. The results from this project and other projects in the lab should significantly further our understanding of the global repression that plays a key role in the regulation of filamentation, which is the most important virulence associated trait in *C. albicans*.

Anthranilic Acid Derivatives as Novel Antibiotics against MRSA and other Gram Positive Microorganisms: Combating Antibiotic Resistance

Nkrumah Grant
McNair Scholar

Roderick Morgan, Ph.D.
Faculty Mentor

Infectious diseases, namely those caused by bacterial microorganisms, are still among the top causes of mortality in the world; however, pharmaceutical support for the development of novel antibiotics against these diseases continue to decline due to the feasibility of synthesizing derivatives with respect to compounds already known to be effective. This practice has inadvertently created a growing problem; over prescription, improper use and disposal of these antibiotics, in addition to the lack of novel antibiotics to reduce natural selection within bacterial populations has led to the emergence of a number of antibiotic resistance microorganisms, chiefly, Methicillin Resistant *Staphylococcus aureus* (MRSA), Vancomycin Resistant Enterococci (VRE), and Extreme Drug Resistant Tuberculosis (XDR-TB). Of these microorganisms, MRSA accounts for 99,000 deaths, 1.7million infections, and 5 billion dollars in costs to the health care system annually; it is therefore pertinent that novel antibiotics are generated. When developing antibiotics though, there are a number of in vivo intramolecular interactions that occur between the drug and host which must be accounted for. These interactions contribute to processes with the potential to deter the use and commercialization of novel antibiotics due to a change in effectiveness in vivo altering drug toxicity, drug dosage, and excretion rates. However, as the advent of MRSA and other resistant microorganisms have emerged, the demand for new antibacterial reagents has caught the interest of pharmaceutical companies.

Since 2007, in contribution to this increased interest, our research group has developed a novel class of antibiotics derived from anthranilic acids. Our class varies in effectiveness with many compounds showing antibacterial activity in vitro at a minimum inhibitory concentration (MIC) ranging 2-64 μg/ml; however, when in the presence of human serum protein (HSP), this value increases, decreasing their effectiveness. Between May and July 2013, 22 additional compounds were generated and tested, 13.6% of which showed antibacterial activity with MIC values ranging 16-128 μg/ml, concentrations that were also found to increase in the presence of HSP. A literature review suggesting that human serum albumin (HSA), a component of HSP making up 65% of its composition, which functions as a transporter of fatty acids and endogenous and exogenous metabolites, led our group to substitute HSA for HSP in a MIC assay which determined that drug inactivation was concentration dependent on HSA.

Further analysis using computational biology revealed that our derivatives did indeed bind to HSA through intermolecular hydrogen bonding between the carboxylic acid region of our compounds and the side chain residues associated with drug binding site IIA of albumin: an interaction resulting in drug sequestration within the hydrophobic pocket cavity. Interestingly, this observation is consistent with the results we have attained with compounds derived without the carboxyl group which show no antibacterial activity. Using this information, our research group is currently synthesizing derivatives with a low binding affinity for albumin or when bound do not lose antibacterial activity by modifying their hydrophobicity and hydrophilicity. If successful, our endeavors will lead to novel antibiotics decreasing the morbidity, financial burden, and mortality induced by MRSA and other antibiotic resistant microorganisms.

Effects of information processing styles and health message format on skin cancer risk perceptions and behavior intentions

Garret Hisler
McNair Scholar

Amanda Dillard, Ph.D.
Faculty Mentor

Effectively communicating the risks of unhealthy behaviors such as smoking, tanning, and unprotected sex has been a widely researched topic in the discipline of health psychology. One area of this research has focused on the type of format used to present the information. In the past, a majority of the research has investigated the factual presentation of information, but an emerging focus has been on the presentation of information within a narrative. So far only a few studies have directly compared the factual format's ability to increase risk perceptions and alter health related behavior to the narrative's ability to do so. These few studies have found inconsistent results regarding whether health information presented in a narrative format will be more likely than health information presented in a factual format to increase risk perceptions and motivate health behavior. These inconsistent findings may relate to the information processing style people use when presented with these messages. To investigate this possibility, we examined the interactive effects of information processing style and health message format on risk perceptions and behavior intentions related to skin cancer.

One hundred forty-seven female college students who use tanning beds were recruited from Psychology 101 courses. Participants were randomly assigned to either read a narrative message or factual message about how tanning beds can increase the risk of skin cancer. Additionally, prior to reading the message, participants were randomly assigned to a set of instructions for reading the messages that would activate either their experiential or rational processing style. The experiential processing style is characterized by using emotions and past experiences to digest information; the rational processing style, on the other hand, uses reason and logic to process information. We hypothesized that participants who experientially processed the information in a narrative message format would increase their risk perception and worry of skin cancer and reduce their intentions to use tanning beds.

A series of ANOVAs were used to analyze the effects of the two factors on risk perceptions, worry, and behavioral intentions. An interaction between message format and processing style was revealed for three separate measures of risk perception as well as for worry. Participants' risk perceptions were most likely to increase when they processed the narrative experientially in comparison to processing the narrative rationally, the factual message rationally, or the factual message experientially. Similar effects were observed for worry. There were no main effects or interactive effects of message format and processing style on behavior intentions.

The present study qualifies inconsistencies in previous research that sometimes show a narrative message is more effective and other times a factual message is more effective. Our findings suggest that although narratives may be a promising route for increasing risk perceptions, they may be most effective when the information is processed in an experiential style.

Keywords: Skin cancer, health messages, narratives, processing system/style, and risk perceptions

Kappa opioid regulation of reward seeking during acute and protracted withdrawal from ethanol

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Faculty Mentor

Alcohol withdrawal can induce short- and long-term changes in the brain's physiology, which leads to behavioral alterations such as increased reward seeking. Though the short-term effects of withdrawal have been extensively studied, less information is available on the long-term effects of alcohol withdrawal. Findings from recent studies involving animal models of alcoholism have suggested that changes in the dynorphin/kappa opioid receptor (DYN/KOR) system may play a part in this alteration in reward-seeking behavior. The goal of the current study was to examine the role of the DYN/KOR system on reward-seeking behavior for saccharin following chronic exposure to alcohol, during both acute withdrawal and protracted abstinence from alcohol. Male Wistar rats (n=16) were trained to self-administer a 0.1% saccharin solution and after developing a preference for saccharin over water, were placed on an ethanol or control liquid diet for approximately 28 days. After removing the liquid diet, rats received intraperitoneal (i.p.) injections of a saline solution. In order to examine changes in reward-seeking behavior during acute withdrawal from ethanol, rats were tested for saccharin self-administration 24 hours later. Following this initial test, rats were then injected i.p. with 20 mg/kg nor-binaltorphimine (nor-BNI) and were examined again for saccharin self-administration 24 hours later. This pretreatment period was chosen because nor-BNI has been shown to be a selective antagonist at the KOR 24 hours after initial administration. Rats were left undisturbed for three weeks after this test and were then examined for changes in reward-seeking behavior during protracted withdrawal from ethanol. Once again, rats received i.p injections of a saline solution and were tested for saccharin self-administration 24 hours later. Following this test, rats were again injected i.p. with 20 mg/kg nor-BNI and were allowed to self-administer saccharin 24 hours later. Ethanol dependent rats showed a decrease in responding for saccharin during acute withdrawal, which is thought to be indicative of an anhedonic-like state, and this was not reversed by nor-BNI. During protracted withdrawal, rats with a history of dependence showed increased lever pressing for saccharin. This increase was attenuated by administration of nor-BNI. Although control rats did not show any significant changes in responding for saccharin 24 hours and three weeks following the removal of the liquid diet, responding for saccharin was also repressed by nor-BNI at the three-week time point. These results suggest that although the rats showed decreased reward-seeking behavior during acute ethanol withdrawal, the DYN/KOR system may not be involved in regulating the proposed anhedonic-like state underlying this behavior. However, the ability of nor-BNI to decrease enhanced reward seeking during protracted withdrawal suggests that the DYN/KOR system may be more heavily recruited in long-term adaptions associated with withdrawal from alchol.

Synthesis of Chiral Silanes

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Faculty Mentor

The lack of a simple, single step synthesis of chiral silanes is an obstacle to the use of chiral silanes in the synthesis of chiral drugs or materials because there are no naturally occurring chiral, non-racemic silicon compounds. Therefore, it would be useful to find a method that provides high yields of chiral, non-racemic, silicon compounds that can be used in synthesizing chiral drugs. Initial studies done in Sommer's laboratory[1] required a multistep synthesis for preparing chiral silicon compounds. This method had poor yields and required much time and hence hindered the use of chiral silicon compounds. Therefore, finding the development of a single-step synthesis for making chiral silanes is important and can lead to several advantages over a multistep synthesis such as it is more efficient, it is less expensive, and it would take less time to make. A previous GVSU student has shown that reaction of a pro-chiral dimenthoxyphenylmethylsilane with nucleophiles can produce a chiral silane with good selectivity for phenyl and methyl groups. In our current study, the overall goal of this project was to find a single-step synthesis that can yield a single enantiomer when the substituents are a phenyl and a vinyl group.

The starting material, dimenthoxyphenylvinylsilane was prepared from dichlorophenylvinylsilane. Dicholorophenylvinylsilane reacted with 2 equivalents of menthoxyllithium in THF solvent to produce dimenthoxyphenylvinylsilane, which was then purified by column chromatography and the product was isolated in a 72.6 % yield. Thedimenthoxyphenylvinylsilane was used for the reactions in preparing chiral silicon compounds. Napthyllithium, butyllithium, methyllithium, and tert-butyllithium reacted with the dimenthoxyphenylvinylsilane to form the chiral silicon compounds. These reactions were performed under N2, in hexane solvent at -78o C except the reaction of dimenthoxyphenylvinylsilane with tert-butyllithium which was done in diethyl ether solvent. After the products were made, these compounds were purified by column chromatography, then they were analyzed with the use of NMR, GC- Mass Spectrum, and HPLC. The yields of these reactions varied from 18.4% to 72.05% and in the case of the methyllithium substitution initial results were consistent with a high selectivity for one enantiomer.

Our hypothesis for the selectivity observed in these reactions is that nucleophiles are more likely to attack the silicon at the more open-side that would lead into a higher selectivity. The crowded side of the dimenthoxyphenylvinylsilane is less likely to undergo nucleophilic substitution because steric-effect would occur and would prevent the nucleophile from attacking the electrophilic silicon atom.

We have investigated the reactions of dimenthoxyphenylvinylsilane with different organolithiums to produce a series of chiral silanes which have been isolated in moderate to good yield. Future studies of these compounds will involve further characterization of the new compounds made and substitution of the menthoxy group with hydride and bromide to form a silicon compound that can be readily used in the synthesis of chiral organic molecules.

[1] Sommer, L., Michael, K., Frye, C., & Parker, G. (1964). Stereochemistry of Asymmetric Silicon. I. Relative and Absolute Configurations of Optically Active Alpha-Naphthylphenylmethylsilanes. *Journal of American Chemical Society,* 86(16), 3271.

Does childhood behavior predict collegiate athletes' sports interests?

Nikole LeCompte
McNair Scholar

Rob Deaner, Ph.D.
Faculty Mentor

The purpose of this study is to explore the relationship between childhood play behavior and adult sports interest. More specifically, we examine whether gender-typed childhood behavior can be used to predict the type of sports adults choose to participate in. This study is part of a larger study that seeks to establish a biological component of gender differences in sports participation and interest that can add to the current theories of socialization. This work could shape how we frame certain U.S. educational policies such as Title IX, and have an impact on how we approach certain societal goals such as reducing the prevalence of obesity through increased physical activity. Despite the focus on socialization as the sole cause of observed gender differences in behavior, there is reason to believe that biology contributes to these gender differences as well. For example, previous research by Campbell and Eaton (1999) and Alexander and Hines (2002) has established a link between androgens and childhood behavior by showing very early gender differences in behavior in humans and distinct gender differences in play behavior among non-human primates. Furthermore, Berenbaum and Beltz (2011) found that females with congenital adrenal hyperplasia (CAH) – who, for various reasons were exposed to abnormally high levels of androgens in the womb – show more male-typical play behavior and preferences than females without the condition. In order to explore the link between childhood behavior and adult sports interest, we used a correlational design. Using SurveyMonkey, we developed a survey to send to collegiate athletes from various schools across the country. The survey included Zucker's 23 item Recalled Childhood Gender Identity/Gender Role Questionnaire and questions regarding the athlete's current primary sport, which sport they would play if given the opportunity and resources, and in which sport they would like to be considered the best in the world. In total, we had 307 participants from Division I and Division III schools (200 females, 107 males). We classified the different sports as feminine, neutral, or masculine based on previous cross-cultural research of sports stereotyping (Lauriola et. al., 2004; Riemer et. al., 2003). Deriving from the premise that biology matters, we suspected that more male-typical childhood play behavior would correlate with a preference for more masculine sports interests and more female-typical childhood play behavior would correlate with a preference for more feminine sports interests. We found that women who recalled feminine childhood play behavior were significantly more likely to participate and indicate interest in feminine sports. We also found that men who recalled masculine childhood play behavior were significantly more likely to report interest in masculine sports. It is likely that we may have found stronger statistical significance for the male results if the response rate had been higher. Overall, however, our hypothesis was supported. Therefore, we have evidence consistent with the hypothesis that biology is at least partly responsible for the observed gender differences. This is not to rule out the role of socialization, but merely to provide a more accurate representation of the issue.

Unionids: Their current status in Cedar Creek and their association with macroinvertebrates

Kristy Moore
McNair Scholar

Eric Snyder, Ph.D.
Faculty Mentor

In North America, it is estimated that 72% of the nearly 300 species of freshwater mussels (unionids) are either extinct or in danger of extinction and only 23% are considered stable. No other group of aquatic animals in North America is in such grave danger. They are one of the most endangered groups of animals on Earth, yet surprisingly little is known about their life history, habitat needs, or even how to distinguish different species. Our project investigated the status of the unionid community in a 3rd order Michigan stream and examined their relationship with aquatic macroinvertebrates.

We sampled randomly selected transects within two separate 100 meter reaches that spanned natural gradient in mussel densities in Cedar Creek to compare unionid and macroinvertebrate biodiversity, density, and species richness. At each site, we sampled macroinvertebrates, unionid mussels, and environmental variables such as visually estimating the percentage of substrate composition. At each site, a Hess Net was used to sample benthic macroinvertebrates, and eight, 0.25m2 quadrats were surveyed for unionids in the area directly surrounding the Hess Net (2m2 per site total)(n=144). We also recorded other environmental variables such as water temperature, velocity, total dissolved solids (TDS), concentration and rate of organic matter (OM) transport at the top of each reach, pH, and specific conductivity. A total of seven freshwater mussel taxa were found including the spike (*Elliptio dilatatus*), plain pocketbook (*Lampsillis cardium*), fatmucket (*Lampsillis siliquoidea*), wabush pigtoe (*Fusconaia flava*), rainbow (*Villosa iris*), and the federally endangered clubshell (*Pleurobema clava*) and rayed bean (*Villosa fabalis*). Mussel density was greater in areas of faster water velocity (p=0.002). Transported OM input into the reach with high mussel density was significantly higher (p=0.0007) vs. the reach with low mussel density (average of 0.076 vs. 0.046 g/m3/sec, respectively). Mussel density was positively correlated with macroinvertebrate density across the randomly chosen 18 sites (p=0.004, R2=0.405). High variation in substrate size and composition was positively correlated with high mussel density vs. more homogeneous in areas with few or no mussels. The data suggest that substrate is a strong determinant of mussel assemblages and as the natural gradient in substrate becomes more homogeneous, mussel abundance and diversity declined. As other research has shown, we found a positive relationship between mussels and aquatic macroinvertebrates. Future research at this site could investigate the mechanisms leading to this association and follow up on our finding that higher mussel density was positively correlated with high variation in substrate, faster water velocity, and higher concentrations transported OM—a likely food resource for both mussels and filter-feeding macroinvertebrates.

GPS-derived Preliminary Vertical Tectonic Motions and Causes, Puerto Rico and Trinidad

Saray Morales
McNair Scholar

John Weber, Ph.D,
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Faculty Mentors

Pablo Llerandi-Roman, Ph.D.
Faculty Mentors

Vertical tectonic motions were studied in the Caribbean using data from continuously operating Global Positioning System stations (cGPS). The island of Puerto Rico (PR) is located in the plate boundary zone between the Caribbean and North American plates. Today, this zone is dominated by east-to-west strike-slip motion with additional minor convergence, which created the PR trench north of the island. Uri ten Brink (2005) developed a series of models that show possible sub-surface trench geometries and possible causes of vertical motion in PR. Differences in long-term (1955-2012) tide-gauge sea-level rise rates from PR suggested that differential vertical tectonic motion might be resolvable. Our preliminary results from seven cGPS sites in PR show that the northernmost sites with sufficiently long time series (2008-2013) may be sinking at rates (2-sigma uncertainties) as follows: MOPR (-1.33 mm/yr ±2.76), MAYZ (-1.47 mm/yr ±2.77), AOPR (-5.33 mm/yr ±2.42), BYSP (-1.26 mm/yr ±1.73) and CUPR (-2.52 mm/yr ±1.76). This contrasts with the vertical motions of the suite of southern cGPS sites, which appear to be more vertically static: P780 (-0.5 mm/yr ±1.94) and MIPR (-0.6 mm/yr ±1.70). Trinidad is clearly tilting to the west into the Gulf of Paria's pull-apart basin based on macroscopic geomorphic features (Ritter & Weber, 2007), and sits in nearly a mirror image plate tectonic setting to PR; Trinidad is located in the southeast corner of the Caribbean plate, in the Caribbean-South American plate boundary zone. In addition, causes of vertical motion are better understood in Trinidad than they are in PR (Weber et al., 2011). Therefore, we also determined preliminary rates of vertical tectonic motion for Trinidad using a similar approach, and we used this island as an analogue to better understand vertical motions in PR. We analyzed data from five Trinidadian cGPS sites (ALBI, CALD, FORT, GALE, GRAN), and from one episodic GPS site (POST) located on the sinking northwest coast.

Our preliminary vertical GPS rates (2-sigma uncertainties) are as follows: ALBI (-2.20 mm/yr ±1.52), CALD (-0.97 mm/yr ±1.36), FORT (0.49 mm/yr ±1.67), GALE (-0.90 mm/yr ±1.78), GRAN (-1.36 mm/yr ±1.62), and POST (-4.21 mm/yr ±1.96). Results from the northwestern Trinidadian sites (ALBI, POST) are consistent with subsidence. FORT on the southwestern coast has apparently moved down and then up, perhaps due to volcano mud inflation/deflation. The other central and eastern Trinidad sites (CALD, GALE, GRAN) appear to be more vertically static. Our study now aims to define local vertical reference frames in PR and Trinidad and to use these to quantitatively solve for the differential vertical tectonic motions on each island. This approach should reduce formal uncertainties and bring the qualitative differential signals described above out of the noise.

Pharmaceutical Advertisements for Arthritis: The Portrayal of Disability and Gender

Casey Overway
McNair Scholar

Rachel Campbell, Ph.D.
Faculty Mentor

The goal of this qualitative, exploratory study is to examine how ability, health, and gender are represented in advertisements for drugs that treat moderate to severe arthritis. Through a content analysis of 53 pharmaceutical advertisements for 14 different drugs advertised in 21 issues of the *Arthritis Today magazine* (2010-2013), the idealized expectations created by these drug manufacturers is examined. Advertisements for arthritis drugs were selected because arthritis is the most common physical condition and the most common cause of disability in the United States. It also disproportionately affects women.

Even though arthritis affects millions of people in the U.S. alone, little research has been done on how pharmaceutical treatments are advertised. While some prior research has focused on the effects of direct-to-consumer (DTC) advertising and whether DTC advertisements give enough information for consumers to make informed decisions, it lacks a focus on the societal implications of DTC advertising. The need for research that focuses on messages in pharmaceutical advertisements is further supported by the rapid growth in spending on DTC advertisements from millions of dollars in the 1990s to billions of dollars by the early 2000s, and the role of advertisements in creating and reinforcing social expectations. Like other advertisements, pharmaceutical advertisements portray society's standards and norms. Thus, this project aims to answer the question: how are disability, health, and gender portrayed in the advertisements?

To better understand what ideals are being depicted, advertisements were coded for manifest content (e.g., men, women, able-bodied, disabled, nature, indoors) and latent content (e.g., gender stereotypes among activities such as caregiving, shopping, cooking). The dichotomies of able-bodied/disabled, healthy/unhealthy, and masculine/feminine empower some while disempowering others. How these dichotomies manifest and embody standards and norms such as hegemonic masculinity and emphasized femininity is explored.

Findings reflect that a majority of depictions are of women rather than men, able-bodied rather than disabled people, and occur in nature rather than indoors. The message that people need to be healthy and pain free is emphasized by portraying more people as able-bodied. This is reinforced by portraying people in nature, which suggests that people need to be healthy, young, and full of life. Within the advertisements individuals are consistently shown representing traditional gender expectations. For instance, in advertisements women are more likely to be shown in supporting roles such as caretakers, homemakers or exercising; men are more likely to be shown participating in sports, showcasing their strength, and being in control. The implication of these advertisements is that the way to live up to these socially constructed expectations is by taking the advertised drug. Thus it is suggested that without the advertised drug a person will be in pain, disabled, and unhappy. Because health is presented as being easily achieved through use of the drug, the realities of arthritis are diminished. Diminishing the realities of arthritis can be problematic because the way society views and treats those affected by arthritis could be impacted by the sometimes unrealistic portrayal of pharmaceutical users as the perfect embodiment of health and ability.

Neurotransmission Within the Crayfish

Rhiannon Robke
McNair Scholar

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Faculty Mentor

Throughout the world, there are multiple species of invasive crayfish emerging. In Europe and parts of Africa, the *Procambarus clarkii* species is of concern. In this study, fast-scan cyclic voltammetry was utilized to observe and measure neurotransmitters in real time that were present near the pericardial cavity in freely moving *Procambarus clarkii* crayfish. Crustaceans, including crayfish, utilize an open circulatory system in which their blood and extracellular tissue fluid, or hemolymph, is pumped by the heart. Within the crayfish open circulatory system, various neurotransmitters are released into their hemolymph and brought back to the heart for circulation. Their heart is located near the dorsum and is centrally positioned below the cervical groove, enabling a consistent and easy location for implantation of a carbon-fiber electrode. Fast-scan cyclic voltammetry allows for quick, accurate data that is recorded in real-time, every 100 milliseconds. Using changes of voltage in carbon-fiber electrodes, fast-scan voltammetry measures the reaction of oxidation and reduction peaks of neurotransmitters caused by the carbon surface voltage changes.

During various behaviors, such as crawling or the meral spread, histamine (HA) was detected and recorded consistently using a histamine-sensitive waveform. Within our study, results show a slight delay in the recording of histamine after a behavior. This could be due to the placement of the recording electrode and a release of histamine taking place a distance from the heart. It is believed that histamine is located in the pyloric region as well as the eyestalk in all crustaceans. Secondly, results show that the release of histamine was dependent on previous displays of aggressiveness and exertion. The display of more forceful behaviors consistently correlated with higher amounts of histamine, with a mean of 258.86 Â± 56.75 ÂµM. Natural behaviors, such as crawling, resulted in a lower average of 123.51 Â± 19.70 ÂµM. It was also found that a continuous behavior, such as crawling, results in a gradual decrease of histamine levels. Once the crayfish comes upon a challenge or threat and an additional behavior is portrayed, a spike in histamine will result. Lastly, histamine levels proved to steadily drop once the crayfish was left alone after a period of aggressive and defensive behavior. Our hypothesis on the role of histamine is that its inhibitory effects within the gastric mill are indeed shutting down the digestive system to allow the crayfish to move, similar to a fight or flight response.

The purpose of this study is to better understand the crayfish general physiology and to assess the role histamine plays in regulating their behavior. Future studies will look to obtain a better understanding of the role of histamine in crayfish behavior by investigating the location of histamine release. By developing a better understanding of crayfish behavior, further investigations of preventative plans can become possible.

Novel Biphenyl Ureas as Regulators of the Trace Amine Associated Receptor

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The thyroid hormone (TH) regulates many physiological functions in vertebrates including the cardiovascular system, metabolism, brain development, and growth. This can lead to serious physiological complications for patients suffering from a thyroid disorder. According to the American Thyroid Association as many as 20 million Americans suffer from thyroid diseases and 60% are unaware of their condition. Many people are misdiagnosed or symptoms go unrecognized because thyroid hormone biology is complicated and not completely understood. Consequently, the treatments for thyroid disorders are limited. The most common treatment is Synthroid, a synthetic thyroid hormone, which is taken orally and is one of the most commonly prescribed medications in the United States.

The thyroid hormone is regulated by a cascade of hormone releases initiated by the hypothalamus, mediating the pituitary gland, and terminating in the stimulation of the thyroid gland. The activated thyroid gland releases TH into the blood stream. A negative feedback mechanism also exists, which terminates the signal from the hypothalamus if the concentration of TH gets too high. The hormones released from the thyroid gland are primarily T_4, the inactive form of TH. T_4 attaches to carrier proteins in the blood and it travels to its target cells. Upon reaching the target cell, T_4 becomes activated through the action of a deiodinase to become T_3. After activation, T_3 activates its nuclear receptor leading to gene regulation and causes an increase in physiological functions. This is a slow process and can take hours or even days to see an effect. The biological processes that increase include metabolic rate, cardiac output, and body temperature among others.

Recent research has shown that T_1AM, a compound found in various tissues throughout the body, may play a role in thyroid hormone regulation. T_1AM acts on the Trace Amine Associated Receptor (TAAR). TAAR activation leads to physiological effects in opposition to those induced by TH. This led to the proposal of a new homeostatic model for thyroid hormone regulation. It was traditionally thought that a person with hypothyroidism was suffering from too little T_3, but the model suggests that they may have too much T_1AM. And for a person with hyperthyroidism it is not that they have too much T_3, but that they may have too little T_1AM.

The goal of this project is to develop novel T_1AM derivatives to better understand the role of TAAR and T_1AM in TH biology. Specifically, these compounds will incorporate an extra phenyl ring, and based on previous work, may be antagonists for TAAR. To this end, a synthesis of our novel phenyl substituted T_1AM derivative was commenced with a commercially available compound. Thus far, the starting material has undergone two transformations: a boc protection and iodination. We have successfully separated the mono-boc protected amine and the mono-iodonated product from the di-products. The next step in the synthesis is the Suzuki coupling, which is currently being examined. Selective regulators for TAAR will be valuable biological tools that may lead to new treatments for thyroid disorders.

The Segmentation of Social Experience

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Previous research has shown that people break up or segment activities into discrete events. Most everyday activities are comprised of both social and non-social behaviors. For example, a trip to the zoo includes social behaviors such as interacting with the person at the ticket booth and non-social behaviors such as following a map to find an exhibit. While there has been some research on how social characteristics affect event structure, little has been conducted that investigates how the perception of social interactions between individuals affects one's segmentation of those experiences into events.

In this study, we tested the effect of changes in social and non-social events on the segmentation of behavior. Additionally, we were interested in how variables like grain size (large vs. small events) and type of personality may influence the segmentation of social events. Grain (fine vs. coarse) can be described as the size of an event. For instance, fine grain (small) events in the experience of preparing breakfast could include picking up a plate, setting it down, cracking an egg, and more. Corresponding coarse grain (large) events in this experience could include taking out plates, scrambling eggs, etc. In relation to personality type, we were specifically interested in the level of extraversion and whether or not it mediates the influence of changes in social actions on a perceiver's event segmentation. Participants were asked to watch four short films of dyads doing everyday activities (making breakfast, doing laundry, etc.) in two separate viewings (fine grain and coarse grain). While watching the films, participants were asked to indicate the points where one activity had ended and another had begun (i.e., segment the activity into discrete events), in a way that felt natural and meaningful to them. In one session participants were asked to break up the films into the largest meaningful units of activity (coarse grain segmentation), and in another session participants were asked to break up the films into the smallest meaningful units of activity (this order was counterbalanced). After the first viewing of each film participants were instructed to complete a recall task by typing in their response. Participants were instructed to describe what they recalled from the film, in order, with as much detail as possible. Lastly they were asked to complete a personality measure to assess levels of extroversion.

Results show that changes in both social and non-social actions predict segmentation and that grain size interacts with this effect. Fine grain event models are more strongly associated with changes in non-social actions and coarse grain event models are more strongly associated with changes in social actions. Level of extraversion did not moderate the extent to which changes in social actions predicted segmentation, or the extent to which changes in social actions were recalled.

Culture, Identity, and Modernity in Contemporary Iranian Photography

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The cultures of the Middle East have often been presented as the antitheses of American and European societies. Popular media such as television dramas and news programs can propagate oversimplified characterizations that encourage expectations of traditionalism and the exotic within these cultures. For many people such depictions have come to represent the environment and people of this culturally diverse region. Contemporary artists from the Middle East regularly challenge these stereotypes in their work while simultaneously critiquing aspects of their own local societies. There are many ways to accomplish this, but one of interest to me is through the medium of photography. This essay explores the works of three Iranian photographers: Bahman Jalali, Shadi Ghadirian, and Shirin Aliabadi.

The art of these three photographers critiques common stereotypes that ask viewers to re-assess their attitudes toward the cultures of Iran. The images discussed in this essay reveal how concepts such as the relationship between modernity and identity can vary from culture to culture. The works are analyzed with an interdisciplinary approach that utilizes elements from Post-colonial theory. As a method, Post-colonial theory examines the ramifications of colonization on cultures from historical, economic, and political perspectives but also in relation to social concerns such as identity. Specifically, hybrid identity is a concept that looks at the local behaviors and traditions that intersect with those of global societies to create a new identity. It is complex because often individuals are frequently expected to align with a single culture and its values, but our identities are influenced by local and global concerns. This tension is revealed in the photographs as the artists explore themes of photography as a medium, the representation of veiling practices, and Westernization in relation to consumerism. Each of these motifs is used by the artists to incorporate ideas about hybrid identity in order to challenge expectations of modernity from local and global perspectives. Some of the artists refer back to Iran's history to show the country's ties with technology, in particular photography, to make misconceptions about Iranian culture more apparent. Other artists achieve this by depicting subjects that embody western cultural values to illuminate the consequences of these ideals.

I conclude that the images invite viewers to question the construction of identity in contemporary societies. The photographs highlight how stereotypes and the frequent assumptions about modernity are problematic. The viewer has to question his or her own biases and assess his or her own society's belief systems. Ultimately, the photographers' work doesn't imply that one society is superior to another. Instead, it reveals the limitations of using cultural assumptions to characterize identity.

Novel Telomerase Inhibitors synthesized from BIBR 1532 derivatives

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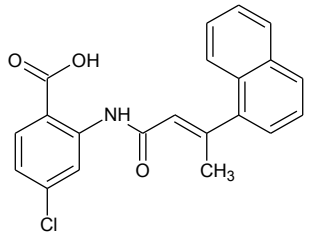
As of 2011, cancer was the leading cause of death in the United States, second only to heart disease. Cancer is often referred to as being "immortal" because of its ability to divide a seemingly infinite amount of times. Normal cells are limited in the number of times they can divide by the caps on the ends of their chromosomes, called telomeres. These caps are supposed to become degraded over time, signaling the cell to die when they become too short. As cancer continues to become an ever-increasing threat to human health, the race is on to find an effective telomerase inhibitor. If telomerase is inhibited, the telomeres of cancer cells can no longer be elongated. Stripped of their immortality, cancer cells will eventually undergo apoptosis, or controlled cell death. This inhibitor has to be able to destroy cancer cells while leaving healthy cells unharmed. Research has uncovered that the molecular structure of a compound known as BIBR 1532 has proven to be an effective telomerase inhibitor. Current research has shown that BIBR 1532 inhibits telomerase by preventing it from extending the copied strand any further than the length of the original strand of DNA.

Research has not yet discovered what portion of BIBR 1532 causes it to be such a good telomerase inhibitor, though several theories do exist. The most popular theory, supported by past research, is that three structures present in the BIBR molecule contribute to its efficacy: an aromatic ring containing a carboxylic acid and a conjugated amine group. This is the theory on which my current research is based upon and served as the basis for the synthesized compounds. Three compounds were made via the synthesis of cinnamic acid and contained the aforementioned substructures found in BIBR 1532. The basic skeleton of the chemical structure was created from cinnamic acid, due to its natural ability to inhibit telomerase. Using the reactive properties of cinnamic acid, several different substituents were added while maintaining the three key structures. The Schotten-Baumann protocol was utilized to synthesize the final product, the purity of which was tested using HNMR and CNMR techniques. The results of this experiment were three novel chemical compounds that each contains an aromatic ring, a carboxylic acid, and a conjugated amine group. These compounds also possess the natural anticancer properties of cinnamic acid.

These three compounds are currently undergoing testing for telomerase inhibition using the Telomerase Repeat Amplification Protocol assay. The compounds will be tested on prostate cancer cell lines, in order to determine whether my compounds are active against telomerase. Their efficacy will be compared against BIBR 1532 itself, as well as other known telomerase inhibitors. The compounds will also be tested to determine if it has the ability to destroy cancer cells, while leaving healthy cells untouched. If one of these compounds is found to be more effective at fighting cancer then BIBR 1532, it would open doors to a newer and safer drug treatment program.



The structure of BIBR 1532

New Modulators of the trace amine associated receptor: meta linked ureas

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Millions of people suffer from thyroid hormone disorders. However, many more are unaware of their condition. Symptoms of thyroid conditions fall into two basic categories: hyperthyroidism with excessive thyroid hormone (TH) levels and hypothyroidism with lower TH levels. The thyroid gland is responsible for the synthesis and secretion of the (TH), which includes both thyroxine (T_4) and triiodothyronine (T_3). The predominant TH produced by the thyroid gland is T_4, which is the inactive form. Recent studies have shown, that T_3 is a metabolite of T_4. This typically takes place at the target tissue or in the liver. The active hormone, T3, is then transported into the cell and binds to a thyroid nuclear receptor (TR). Normally, T_3 mediated TR activation leads to the control of various biological processes: core body temperature, heart rate and metabolism. This activation process is typically slow ranging anywhere from hours to days. In the case of hyperthyroidism, patients exhibit increases in their core body temperature, heart rate and metabolism. Alternatively, patients with hypothyroidism experience a decrease in these biological processes.

Recently, a naturally occurring metabolite, 3-iodothyronamine (T_1AM) was discovered to elicit a rapid physiological response in mice. These include a decrease in core body temperature, metabolism and heart rate. T_1AM is a potent agonist of an orphan G-protein coupled receptors (GPCR) known as the trace amine-associated receptor ($TAAR_1$). GPCRs are known to mediate rapid cellular responses. If we consider these opposing physiological effects of T_1AM and TH it is possible that T_1AM and T_3 work in conjunction to provide a regulatory mechanism of TH activity including cardiac output, body temperature, and metabolism.

Studying this mechanism may lead to a greater understanding of TH biology. Our lab has been interested in developing novel derivatives of T_1AM as a means of examining this mechanism. Previously, we have found that incorporating a urea functional group in place of the ether linkage of T_1AM has led to significant $TAAR_1$ activation. These derivatives contained a para-linked aromatic system. The goal of this project is to expand on this structure activity relationship by examining a meta-linked aromatic system. Additionally, the length between the two aryl groups will be examined by insert 0 to 4 methylenes. To this end, the five targeted meta-linked ureas were synthesized utilizing a four step synthesis. These compounds now await biological evaluation in the next phase of the project. By achieving a greater understanding of T_1AMs role in thyroid hormone biology there may be more opportunities for treatments of patients who are suffering from thyroid hormone disorders.

About the TRiO Programs

To fight the war on poverty, our nation made a commitment to provide education for all Americans, regardless of background or economic circumstances. In support of this commitment, Congress established several programs in 1965 to help those from low-income backgrounds and families with no previous college graduates(first generation). The first three programs established were Talent Search, Upward Bound, and Student Support Services. Thus, they are know as the TRiO Programs.

Since then, other programs have been added, including Upward Bound Math and Science, Educational Opportunity Center, The Training Authority, and in 1989, The Ronald E. McNair Post-Baccalaureate Achievement Program. The goal of all of the programs is to provide educational opportunity for all.

The Ronald E. McNair Post-Baccalaureate Achievement Program is designed to prepare highly talented undergraduates to pursue doctoral degrees. In addition, the goal is to increase the number of students from low-income backgrounds, first generation college student and under-represented minorities on college and university faculties.

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