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Forward Thinking Poster Session/Colloquy Presentation
Past Award Recipients

2011
Legal and Extra-Legal Factors Impacting Domestic Violence Injunctions in Milwaukee
> Dr. Heather Hlavka, Assistant Professor, Social and Cultural Sciences; Dr. Sameena Mulla, Assistant Professor, Social and Cultural Sciences, Kate Hanson, and Chelsea Pierski

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> Dr. Lars E. Olson, Associate Professor, Biomedical Engineering; Dr. M. Therese Lysaught, Associate Professor, Theology; Christopher Hallberg, Clinical Trial Coordinator; Ellen Hawkinson, Katelynn Kramer, Brian Laning, Sarah Schmiedel, and Andrew Weingart

Parent and Family Outcomes of PEERS: A Social Skills Intervention for Adolescents with Autism Spectrum Disorders
> Dr. Amy Vaughn Van Hecke, Assistant Professor, Psychology, and Jeffrey Karst

2010
The Amader Gram Breast Care Palliation Study: Phase 1
> Dr. Sheikh Iqbal Ahamed, Associate Professor, Mathematics, Statistics and Computer Science, Ferdaus Kawsar, Mohammad Tanviruzzaman, Md. Munirul Haque, and Mohammad Adibuzzaman

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> Dr. Jeffrey J. Berry, Assistant Professor, Speech Pathology and Audiology and Mary Bolgert

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> Dr. Lisa Edwards, Assistant Professor, Counselor Education and Counseling Psychology, Brittany N. Barber and Keyona Jarrett

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      Dr. Dale Noel, Professor, Biological Sciences, and Robert Stone

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      Dr. Astrida Kaugars, Assistant Professor, Psychology, and Christopher J. Fitzgerald

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Imaging of the Human Brain during Pedaling
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Neurotoxicity of BMAA in Cortical Cultures
      Doug C. Lobner, Associate Professor, Biomedical Sciences, and Peachy Mae T. Piana

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      Debra L. Oswald, Assistant Professor, Psychology, and Kristine Chapleau

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Dr. Laura Matthew
Assistant Professor
History
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Dr. Iqbal Ahamed
Associate Professor
Mathematics, Statistics and Computer Science
"Findings from the deployment of e-ESAS: a remote symptom monitoring system for rural breast cancer patients in Bangladesh"

2010

Dr. Stephani Richards-Wilson
Assistant Dean for Recruitment and Retention
Klingler College of Arts and Sciences

Dr. M. Therese Lysaught
Associate Professor/Director of Graduate Studies
Theology

Dr. Lars Olson
Associate Professor
Biomedical Engineering

Dr. Sharon Chubbuck
Associate Professor
Educational Policy and Leadership

2009

Dr. Eugenia Afinoguenova
Associate Professor of Spanish
Foreign Languages an Literatures

Dr. Ruth Ann Belknap
Associate Professor
College of Nursing

Dr. Irfan Omar
Associate Professor
Theology

Dr. Toni Roucka
Assistant Professor and Predoctoral Program Director of General Dentistry
General Dental Sciences

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FORWARD THINKING POSTER PRESENTERS

PROJECT TITLE: Integrating high-throughput biological datasets to discover drivers of glioblastoma
FACULTY NAME: Serdar Bozdag, PhD, Assistant Professor, MSCS
STUDENT NAME: Yemalin Godonou, MSCS

INTRODUCTION

Glioblastoma multiforme (GBM) is the most common malignant brain tumor [1]. GBM patients have a median survival of about fourteen months despite aggressive treatment. The main cause of GBM is that the regulatory mechanism that governs the gene activity gets out of control in the tumor cells. To characterize the GBM disease and shed light on its regulatory mechanisms, several international consortiums have been established. One of these consortiums is the Cancer Genome Atlas Project (TCGA) [2], which has generated high-throughput genomic, genetic, and epigenetic datasets for a cohort of about 500 GBM patients. Given these huge datasets, one of the main challenges is to integrate them through computational and machine learning approaches to discover potential drivers of GBM.

In this project, we plan to apply random jungle [3] algorithm to build a machine learning framework that incorporates high-throughput GBM datasets in the TCGA database. Our framework will be able to report which genomic events are the potential drivers of GBM. We aim to provide several testable hypotheses for biologists to verify, which will eventually translate into new effective therapeutics for GBM patients.

SIGNIFICANCE

GBM is a very deadly disease and as of today there is no therapy for it. To understand more about the genomic complexity of the disease, several high-throughput datasets have been generated recently. Since each of these data sets represent one facet of the GBM biology, computational approaches that incorporate them into a single framework are essential. The main goal of this study is to integrate these datasets and compute genomic events that are potential drivers of GBM. Our tool will provide a short list of genes and gene sets as potential oncogenes of GBM. Cancer biologists could experimentally verify our computationally derived hypotheses instead of attempting to verify all the genomic events, which are thousands. Our work will expedite the process of understanding more about the GBM disease and developing effective therapeutics for GBM patients.

FORWARD THINKING/INNOVATION

Most of the studies that aim to discover drivers of cancer analyze only one type of dataset. However, in this project, we incorporate several types of datasets to build a more informative framework. Through incorporating different data types, we will be able to assess the contribution of each dataset and their combinations to the overall gene activity in GBMs. Our study will able to assess if any of these datasets are more informative than the others in terms of characterizing the disease better.

STUDENT INVOLVEMENT

I am working with Yemalin Godonou in this project. Yemalin will install the random jungle software on the Pere cluster at Marquette University. We decided to use random jungle on a computing cluster to obtain the results faster. Yemalin will download and preprocess the TCGA datasets to make it compatible with random jungle then run the software and postprocess the results to report which genomic events describe how much variation in the gene activity in GBM. We will provide our results in tabular format and visualize them in a gene regulatory network diagram by using tools such as Cytoscape [4].

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PROJECT TITLE

Cusp Catastrophe Models for Cognitive Workload and Fatigue in Financial Decision Making

FACULTY PI

Stephen J. Guastello, Ph.D., Department of Psychology

INTRODUCTION

Financial decisions are subject to numerous forms of bias, including overweighting certainty, asymmetric valuations of gains and losses [1], bounded rationality when there is too much information to process [2], overconfidence, and various types of statistical forecasting errors. This study focusses on the first three specific research objective is to build models for performance changes under conditions of increasing cognitive workload and fatigue based on the theoretical approach developed by the lab for other types of cognitive operations [3, 4].

SIGNIFICANCE

The separation of the impact of cognitive workload and fatigue on performance has been notoriously difficult to separate [5], but it has been possible to do with an experimental design that was conducive to testing the two cusp catastrophe models shown in Figs. 1 and 2 which describe processes that produce discontinuous changes in performance. Although they share mathematical structures, the control variables in each process are different and originate from different underlying dynamics or mechanisms. The research program tests the models in a variety of task situations. In so doing it will be possible to find a range of psychological variables that contribute to elasticity or resilience in the workload model, and compensatory abilities in the fatigue model. Compensatory abilities are those that are not directly related to the task, but provide an additional resource to the primary abilities needed for the task.
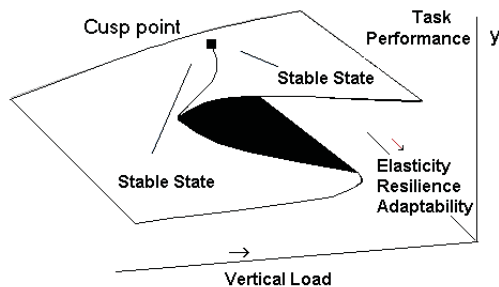
Fig. 1. Work performance as a function of elasticity and level of work load.
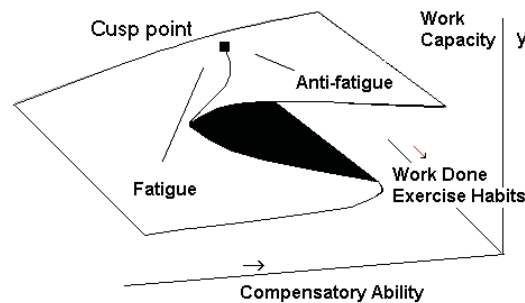
Fig. 2. Two stable states of arm strength as a function of work actually performed and compensatory strength.

FORWARD THINKING

Financial decisions are a particularly interesting application of the theory because two dependent measures are actually involved with every decision. One is whether decisions are producing optimal returns, and the other is the level of risk taking. As a general rule, however, risk taking increases under conditions of stress. Thus one would expect risk-taking to increase in approximately the same conditions as performance drops, and vice versa.

STUDENT INVOLVEMENT

These students are involved in the design of the experiments, creating research material and measurements, running the experiment sessions, and data analysis. Matthew Malon, David Poggi, Katherine Reiter, Anton Shircel, Paul Timm, Hillary Gorin, Megan Fabisch, and Kelsey Weinberger.

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PROJECT TITLE: Barriers and Facilitators of Suicide Risk Assessment in an Emergency Department:
Perspectives from Health Care Providers
FACULTY NAME: Stephen M. Saunders, Ph.D., Professor, Psychology
STUDENT NAME: Megan L. Petrik, M.S., Clinical Psychology Doctoral Student

INTRODUCTION

Approximately 36,000 suicide deaths occur annually in the United States, which translates into one death every 14 minutes. In addition, 8.3 million American adults seriously thought about suicide in the last year. Hospital emergency departments (EDs) are critical sites for identifying and intervening with patients with heightened suicide risk. A person who dies by suicide is more likely to have sought care at an ED in the year before death than from a mental health professional. Individuals who visit an ED prior to suicide typically do so within one month before death. However, assessing suicide risk in EDs is a complicated task for many reasons (e.g., high patient volumes and limited mental health training among staff). The overall goal of this project is to improve the identification of and care for ED patients with heightened suicide risk. This study will assess ED providers' perspectives regarding the barriers and facilitators of assessing suicide risk in emergency medicine. This information will be used to develop an efficient suicide risk assessment protocol, based on the expertise of actual providers, which could be integrated into routine emergency medical care.

SIGNIFICANCE

There are no evidence-based practice guidelines for the assessment, management, and disposition of patients who present to EDs with a heightened risk for suicide. Failure to accurately identify suicide risk is associated with significant consequences for both ED patients and staff. High-risk patients that go unidentified are more likely to return for future ED services and they are more likely to ultimately die by suicide. Providers are at higher risk for occupational burnout when patients with suicide-related concerns repeatedly utilize ED services. Emergency physicians may face malpractice lawsuits if they fail to identify an individual who commits suicide after discharge. It is necessary to gain a better understanding, especially from the perspective of ED staff, about factors that would facilitate or obstruct suicide risk assessment in clinical practice.

FORWARD THINKING/INNOVATION

This study is the first to utilize a bottom-up, inductive approach (i.e., asking for providers' perspectives) to create recommendations for integrating suicide risk assessment in routine ED care. Historically, hospital accreditation bodies have implemented preventative health care services in a top-down manner, and this approach has been linked to staff resistance to a new protocol. In contrast, recommendations derived from the experiences of front-line health care staff have the potential to generate more a widely acceptable, feasible, and efficacious protocol. Once developed, the protocol will be investigated in future studies of suicide risk assessment strategies in EDs.

STUDENT INVOLVEMENT

Megan Petrik, M.S. will act as the lead investigator for this study under Dr. Stephen Saunders' mentorship and support. Ms. Petrik has established good relationships with faculty in the Departments of Emergency Medicine at the Medical College of Wisconsin/Froedtert Hospital, Oconomowoc Memorial Hospital, and Waukesha Memorial Hospital. These partnerships will allow her to enroll ED providers from these hospitals as participants. Ms. Petrik will collect the data, which includes surveys and in-depth interviews, and is also responsible for data entry, analysis, and interpretation.

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PROJECT TITLE: Neural Responses to Social Skills Intervention in Adolescents on the Autism Spectrum: An Extension of the PEERS Research Project
FACULTY NAME: Amy Vaughan Van Hecke, PhD, Assistant Professor, Psychology
STUDENT NAME: Sheryl Stevens, M.S., Clinical Psychology Doctoral Student

INTRODUCTION

The prevalence rate of autism spectrum disorders (ASDs) has been rising steadily, increasing over ten-fold over the last twenty years, and is currently estimated at approximately 1 in 88 children[1,2]. ASDs are brain based, developmental disorders thought to be related to ongoing disruptions in typical neuroplasticity causing abnormal development of social brain circuitry[3,4]. Given the growing number of individuals living with these disorders, the development of empirically validated psychological and biological treatments aimed at decreasing symptomology and improving quality of life has become a central aim of investigation in the field of ASD research.

SIGNIFICANCE

While it was once believed that the brain existed in a static state following the extremely dynamic neurodevelopmental period of infancy, we now recognize the nervous system as a system in constant flux over the lifespan, and have identified a second critical period of heightened plasticity during the adolescent years[2,5]. Due to this recent neuroscientific interest in adolescence, interventions aimed at this developmental stage are beginning to gain attention. A variety of studies investigating neural modification resulting from adolescent treatments have focused on direct neurophysiological manipulation[3,6]. A number of behavioral treatments are also in development, but lack the support of neural markers of treatment outcome success as few researchers interested in behavioral treatments have overlapping experience with neural investigations. One behavioral intervention recently developed for teenagers is the Program for the Education and Enrichment of Relational Skills (PEERS)[7]. While this treatment has been empirically validated with behavioral outcome data[8], the only work on the program's neural outcomes is being completed at Marquette.

FORWARD THINKING/INNOVATION

As the neuroscientific and psychological communities begin to identify the importance of merging their work, experiments such as this one aimed at marrying practices from both fields are becoming increasingly called for. Particularly innovative here is this project's plan to investigate changes in neural responses to social stimuli after treatment. Of the little research currently being conducted in search of biological markers of successful treatment outcomes, most is focused on neural activity collected while at rest. This study, by comparison, will expand the field by investigating neural activity occurring in response to treatment specific stimuli by collecting electroencephalographic data while subjects view a video demonstrating social communication. Dr. Van Hecke has ongoing plans for expansion of this work in various populations and in collaboration with various campus departments, and Ms. Stevens will use the information gained from this study extension for use in her dissertation.

STUDENT INVOLVEMENT

The larger PEERS project is overseen by Dr. Amy Van Hecke and being completed in collaboration with graduate students Sheryl Stevens, M.S., Jeffrey Karst, M.S., Kirsten Schohl, and Bridget Dolan. Ms. Stevens, in conjunction with the other graduate student team members, will continue to recruit participants, and complete the study's intake and follow-up procedures (confirmation of diagnosis, assessment of cognitive abilities, administration of self-report measures, and completion of EEG data collection). Dr. Van Hecke and Ms. Stevens will oversee analysis of EEG data and collaborate with students in the biomedical engineering program to develop an automated EEG analysis protocol.

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PROJECT TITLE: *mHealthMTT: Bridging the gap in communication using a mobile based intervention for maternal and child healthcare in rural Bangladesh.*

PROJECT CATAGORY: Applied Research

FACULTY NAME: Sheikh Iqbal Ahamed, PhD,

STUDENT NAME: Farzana Rahman, Majumder, A. K. M. Jahangir, Colin Ostberg, Kristina Mensch, Syam Ahmed

SIGNIFICANCE: Complications during pregnancy and childbirth is still a leading cause of death and disability among women of reproductive age in rural areas of developing countries[3]. According to BRAC study – "A woman dies in every 45 minutes in Bangladesh due to pregnancy related complications, and a child less than 1 month old dies in every 4 minutes because of less accessibility through proper health care"[brac.org.bd]. The health status of rural mothers and infants can be largely improved by eliminating existing barriers, health disparities and accessing to high quality, comprehensive maternal and child healthcare in remote areas. In this regard a mobile based Remote Symptom Monitoring System can bring about a likely revolutionary part. Fortunately 76.4 million people of Bangladesh are already imbued with mobile phone by 2011 [2].

OVERVIEW AND GOALS: Employing omnipresent potential power of mobile phones by asking 12 elementary sms based questions regarding pregnant mother and baby answered by patients themselves, sending those answers to health caregivers and doctors as well as providing motivational massage and referral information will assist to execute follow-up maternal and child healthcare, alert generation for emergency maternal and child care, and awareness generation. We believe the overall system will be able to ameliorate the quality of maternal and child healthcare in developing countries like Bangladesh, India, Africa through enhanced clinic visit experience, timely intervention, and enhanced 3 way communications (patients, caregivers, and doctors).

NEXT STEPS AND RESEARCH POTENTIAL: In order to attain this project a real success we need to reach the mass poor people of the villages.[1] For that we design to formulate a SMS based questionnaire for low end mobiles. The software will ask questions, collect answers, and then send the data as SMS. There will be a SMS server to receive the senders' SMS as well as transmit necessary data to health workers and emergency services if needed. We also plan to develop a forum for pregnant mother where they can submit voice based questions and answers. We choose the audio version since most of the rural women do not know how to write. Simultaneously it will have a FAQ section with answers from experienced doctors relating to nutrition, immunization, ANC, PNC, breastfeeding etc. We believe such a platform is highly necessitated by pregnant mothers to express their closed thoughts and to increase their social interaction

REFERENCES:

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1) Title: *Global Advertising Creative Departments: The Under-Representation of Women*

2) Category: Applied Research

3) Researcher & Department: Jean Grow, Strategic Communication

4) Overview & Goal:

The objective of my long-term research agenda is to explore the under-representation of women in advertising creative departments across the world. This research is important ethically, socially and economically. First, everyone deserves a fair shot at the same job within a reasonably hospitable work environment. My early research strongly suggests that this is not the case in most creative departments, where women account for 15 to 20 percent of all creatives (Grow, Roca & Broyles, 2012; Mallia, 2009). Additionally, 81.7 percent of American advertising students are women (Fullerton & Kendrick, 2009). These numbers repeat themselves worldwide (Grow & Broyles, 2009 & 11). Second, gender-balanced perspectives could lead to messages that would more successfully appeal to the people making consumption decisions, 80-85 percent of whom are women (Jordan, 2009; Mallia, 2009). Third, balanced and positive portrayals of women in advertising could influence the overall perception of girls and women within societies across the globe.

My previous work in this area has begun to expand the dialogue on this topic globally, with three publications: two on American and Canadian women, one on American and Spanish women. My current work expands into Europe with a focus on women in Sweden and Italy. This summer I plan to complete the analytic portion of my European work in collaboration with, Rossella Gambetti, from Milan. To contribute to the body of knowledge, this research addresses two central questions, always with an eye toward solutions. How do the experiences of women and men working in creative departments differ? How do those differences impact the ability of women to function and flourish? It is framed by social roles and cultural convergence theories and methodologically based on in-depth interviews.

4) International Component and Significance:

On a global level there is also a spectacular lack of diversity within advertising agencies, particularly within creative departments (Gregory, 2009; Grow, Roca & Broyles, 2012). Research addressing cultural convergence is imperative for a comprehensive understanding of our ever-expanding and highly diverse global marketplace (de Mooij, 2010; Taylor, 2010). This in turn may encourage greater gender balance within creative departments. In our rapidly changing world a diverse world of ideas is more than ever needed.

5) Next Steps & Research Potential:

I plan to complete the analytic portion of my European work this summer. Additionally, I am collecting initial data from Peru and hope to go deeper into South America after completion of my European work. I hope to publish three articles (one each on Sweden and Italy, and a European comparison) along with presenting at multiple academic conferences. Finally, when completed, this work has the potential to make a substantive difference to the academy, the advertising profession and the creative women who work there and to industry clients. In short, it will add sorely needed insights, which could lead to hiring and retaining more female creatives, thus enhancing the diversity of voices in global advertising.

PROJECT TITLE: Analyzing Cellular Elements in Saliva from Patients with Oral Aphthous in Taiwan
PROJECT CATEGORY: Pure Research
FACULTY NAME: Stephen Hou, CLS at Marquette University; Soo-Ray Wang, MD PhD at Chung Shan Medical University, Taipei, Taiwan

Overview and Goals of the Project

This proposal is to extend an established protocol in analyzing salivary cellular elements [1] to patients with oral aphthous. Based on size and nucleic acid content, there are various cellular elements present in saliva. We may find larger elements (epithelial and white blood cells) and smaller elements (oral bacteria and subcellular microparticles). Patients suffering with oral aphthous, particularly the recurrent type, could present a cycling changes of salivary cellular elements. Even though the etiology is still unknown, the dynamic changes of oral bacteria [2] and other elements could be potential factors leading to this condition. We aim to discover parameters preceding to the onset of ulceration, and those associated with recovery phase. In other words, we attempt to describe the pathophysiology of oral aphthous using salivary cellular elements. We well be examining preserved first morning saliva collected through draining protocol, since specimens acquired using this protocol are less likely to be affected by drinking and eating.

Description of International Component and Significance/Purpose

We are planning to study patient population with oral aphthous in Taiwan. It is particularly meaningful since a significant number of people are chewing betel nut there. This habit not only results in chronic oral ulceration, it also increases the likelihood of oral cancer [3]. We believe the methodology and data presented in this study will become an important tool to assist the management of this oral ulcerative condition. In addition, it can be easily applied to other countries for similar oral conditions.

Next Steps and Research Potential

After we identify the preceding parameters leading to the onset of oral ulceration and those during recovery phase, we could start looking at timing of administering certain medication. It has been reported that dapsone [4] is an effective and safe medication. It would be important to define the best time to start this medication. Analyzing salivary cellular elements could provide an objective approach to the timing issue, in conjunction with clinical symptoms and physical examination. Furthermore, from patients' point of view, the possibility to visualize salivary cellular elements using a portable microscope could be a great tool to educate patients regarding when to seek medical help or when to initiate a change in daily routine.

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Stochastic Models for the Autodissemination of Insecticides by Mosquitoes

Samson S. Kiware[1,2]*, Silas Majambere[1], Stephen Merrill[2]
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Abstract

Background: Vector control techniques that complement indoor residual spraying (IRS) and long-lasting insecticidal nets (LLINs) may be needed to achieve malaria elimination. Semi-field system (SFS) experiments were conducted to evaluate the potential for the autodissemination of insecticides by adult mosquitoes into their breeding sites and its impact on adult mosquito emergence.

Methods: We present differential equations models based on mosquito's life cycle and SFS experimental data to help design field trials for the autodissemination of insecticides by adult mosquitoes. Specifically, we will use the models to address the following questions: (1) What amount of contamination stations are required to give a 95% emergence inhibition (EI) of adult mosquitoes? (2) How often is it required to re-treat the contamination stations with insecticides? (3) What is insecticides accumulation, persistence, degradation over time in breeding sites?

Results: The EI lab experiment and simulation of the data provide target insecticides amounts for different EI percentages. Preliminary results suggest the minimum amount required, treatment intervals in stations, and degradation in breeding sites over time.

Conclusion: Mathematical models parameterized using semi-field experimental data are used to design field trials for the autodissemination of insecticides by mosquitoes.

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Project Title: The mechanism of "Chinese traditional teeth tapping" in maintaining alveolar bone

Faculty Name(s): Dawei Liu DDS PhD, Department of Developmental Sciences/Orthodontics

INTRODUCTION Periodontal degeneration exists in 8-30% of adult population and can lead to loosened or eventual loss of teeth[1]. Different from the expensive and invasive methods e.g. periodontal cleaning, scaling and anti-inflammatory drug therapy in treating periodontal bone loss, "叩齿" (teeth tapping) has long been used in China to maintain periodontal support e.g. alveolar bone. The typical application is to naturally tap teeth (gently putting upper and lower teeth together) 36 strokes per time, twice daily[2]. However its mechanism has never been unveiled, preventing us from popularizing this inexpensive, non-surgical and non-pharmaceutical method to maintain alveolar bone. A recent study done at NYU[3] showed that high frequency vibration increased the volume of alveolar bone in rats, which however is irrelevant to human being and did not clarify its mechanism. Based on these, the aim of our current study is to use a cell culture model to explore the mechanism of the effect of low frequency vibration (mimicking teeth tapping) on maintaining alveolar bone.

SIGNIFICANCE The cellular mechanism of "teeth tapping" has never been studied, which prevents us from popularizing this method to maintain alveolar bone especially in periodontal patients. Completion of this project will not only provide us scientific evidence of the Chinese traditional "teeth tapping", but also lead to an evidence-based clinical strategy of "tapping teeth" to maintain alveolar bone. In addition, the preliminary data to be obtained will allow us to apply for an extramural funding from NIH.

Description of Past Research (*if applicable*): Funded by NIH, Dr. Liu's group has successfully completed a series of studies exploring the effects of vibration on bone cells. These experiences laid down a solid foundation for the current study to be successfully executed.

International Partnerships/Connections
As a visiting scholar to Dr. Liu's lab, Dr. Zhibin Chen came from the Department of Periodontology Peking University School of Stomatology China. Dr. Chen was trained in Chinese traditional medicine and periodontology, a perfect fit to this project. Internationally, Dr. Liu is looking forward to working with Dr. Chen and collaborating with Dr. Chen's home institution to execute this project.

Next Steps
We will subject the human periodontal ligament (PDL) cell line #2630 cells, the mediator in the mechanotransduction in PDL, to various patterns of vibration (magnitude: 5, 10, 20μm displacement; frequency: 5, 10, 20 Hz) for 1 hour. Five minutes after the onset of vibration, an aliquot of medium will be collected to measure the released early signaling molecules ATP and NO. After vibration, we will harvest the cells to examine the mRNA expression and protein production of three major bone metabolic markers: SOST- a negative bone formation regulator, OPG and RANKL – two key regulators in bone resorption.

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PROJECT TITLE: Building mHealth System for Pediatric Patients with Sickle Cell Disease

FACULTY: Sheikh Iqbal Ahamed, Ph.D, Myrvik, Matthew, Ph.D.

STUDENT: Md Osman Gani

INTRODUCTION

Sickle Cell Disease (SCD) or Sickle Cell Anemia is a blood disorder in which the red blood cells look like farm tool sickle and become stiff and sticky [1]. Normal blood cells are disc shaped and easily move through blood vessels. As sickle cells are hard and sticky, they block blood flow in the blood vessels and deliver less oxygen to the body's tissues which can cause infection, pain, acute chest syndrome and stroke. SCD present at birth and a lifelong disease. It is inherited when the child receives one sickle cell gene from each parent. Pain is the most common complication of patients with SCD. Most of the patients have painful period called crises which can last for hours to days and can cause pain in the backbones, long bones and the chest. Younger children with SCD can have abdominal pain. Patient's regular pain can cause functional disabilities like sleep disorder and lower the quality of life. Nowadays' Smartphone's are equipped with various sensors such as accelerometer, gyroscope, magnetometer, pressure sensor and proximity sensor [2], [3]. People are using Smartphone every day and everywhere. It offers good computational power, motion-sensing capabilities and at the same time it is relatively low cost. Smartphone can be used to help the assessment of disease symptoms, pediatric pain and sleep.

SIGNIFICANCE

Millions of people all over the world are affected by SCD. It is mostly common in African and Mediterranean area. The exact number of people with SCD in the United States is unknown but it is estimated that there are 90,000 to 100,000 affected people. It occurs among about 1 out of every 500 African-American births. An efficient system for the assessment of pain, sleep disorder and daily activity can be a helpful tool for pediatric researcher [4]. Such system based on Smartphone will be cost effective and at the same time will provide mobility to the user.

FORWARD THINKING / INNOVATION

Our goal is to design and develop system on Smartphone to 1) monitor sleep/wake pattern 2) monitor daily activity pattern 3) record pain and other data (e-diary). Existing methods for sleep/wake and activity monitoring have some disadvantages like lack of mobility, requiring subject to wear sensors, needs additional infrastructure, and they are expensive. Movement during sleep, ambient sound, and light/darkness can be helpful to identify sleep pattern. These parameters can be found using camera, accelerometer, gyroscope and ambient sensor of Smartphone. Some basic human activities are walking, running, standing, sitting and lying. Also there are complex activities like cooking, watching TV, playing etc. These activities can be recognized using location, time and some other parameters. GPS and Wi-Fi can be used to identify outdoor and indoor location on Smartphone. Smartphone based electronic diary can be an effective tool for recording and analyzing patient's pain experience, sleep/wake pattern and daily activity pattern [5]. This information can be stored in a remote database to make it accessible any time from any place.

STUDENT INVOLVEMENT

Md Osman is working on design and development of the proposed system using Smartphone.

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PROJECT TITLE
Physiological Monitoring of Emotions
FACULTY NAME(S)
Sheikh Iqbal Ahamed, Ph.D.
STUDENT NAME(S)
Niharika Jain, Mohammad Adibuzzaman

INTRODUCTION
Emotions are important for the existence of mankind and serve as mean to non-verbal communication. They play a significant role in decision making, perception and learning. The study of human emotions which includes identifying, construing and simulating them makes the core concept behind affective computing. There is no clear understanding on the order in which brain processes occur after a particular event [1] and that is why there are different theories behind emotion recognition. In our day-to-day life, we take cues from the information corresponding to facial features, body posture, gestures, speech, physical state etc. and try to perceive the emotion being experienced by others. In similar ways, we can make use of technology and use devices or sensors to capture the same information for emotion recognition through machines. For example, facial features, gestures etc. could be captured by using a camera and speech by microphone.

SIGNIFICANCE
Affective computing deals with developing such machine or computer which is not only able to recognize, interpret and process emotions but also able to make decisions according to the situation. This means that for a computer to be naturally and truly intelligent, understanding emotions is a must. Affective computing finds its applications in the areas of social networking, advertising, health-care and other applications involving Human-Computer Interaction (HCI). Facial expressions, speech and body posture give us more perceptible information about the emotion being experienced as compared to physiological parameters [2] like heart rate, muscle activity, etc. With the advancement in technology and also the increasing number of smartphone users, we want to explore the idea of capturing emotions using mobile devices.

FORWARD THINKING/INNOVATION
When smartphone is becoming such an integral part of our lives we should not let go the opportunity to harness its powers. Smartphone has the capability of making our jobs easier to accomplish and that too with just a touch of a button. Moreover, there is not a need to carry any heavy equipment or device around; the only thing needed is your smartphone. This also avoids adding to the cost factors and hence makes the whole process affordable, convenient and accessible from all aspects. Keeping these things in mind, we want to use smartphones to capture the physiological information pertaining to the emotional state of a person.

STUDENT INVOLVEMENT
Niharika and Adib are doing a literature study in this area. Adib is working on using the smartphone to capture physiological information. Niharika is working on how to map the data collected to a particular emotion and is also studying one of the application areas of affective computing such as Autism.

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PROJECT TITLE
RehabCounter: **A Smartphone-based Assessment Tool for Rehabilitation Therapists**
FACULTY
Sheikh Iqbal Ahamed, Ph.D., Roger Smith, Ph.D.
STUDENT NAME
Ishmat Zerin, Casey J O'Brien

INTRODUCTION

Providing faster and better accessible health service at lower price is a major global challenge in the health care sector [1]. To address this challenge, mHealth works to make the treatment process easy, portable and flexible. Remote patient interaction, advising, monitoring patient performance, recording doctors observations as well as patients' self-observations regarding their own health related behavior now have the possibility of being facilitated by smartphones [2]. Rehabilitation is a restoring process that helps injured or disabled people to get back their maximum level of independence. This process relies upon precise clinical perception and decision-making. The focus of such a program is to plan, guide, and progress rehabilitation so that patients can avoid re-injury and return to their optimal level [3]. Therefore considering the current demand of healthcare services and rehabilitation program, in this poster, we are introducing RehabCounter, a smartphone-based iOS application that allows rehabilitation therapists to define, execute, and validate single-subject design programs tailored to the specific needs of each patient. This application can record quantitative data about a patient's mobility, strength and fitness and provide significant evidence-based graphs of individual patient's activity. To the best of our knowledge, this is the first smartphone-based rehabilitation application that can efficiently and precisely collect or store data as well as can incorporate different types of progress graphs over time.

SIGNIFICANCE

There are a number of existing smartphone and web applications for rehabilitation therapy but most of them merely focused on precise data collection and assessment. We could not find any current application that emphasizes on precise data collection with immediate analysis of an individual patient's performance over time. But the fact is these features can eventually drive patient's progress from one phase of treatment to another. Rehabilitation therapists are actively working with patients to recover them from chronic conditions or injuries, restore the optimal function of injured area, and prevent re-injury. So it is really important to support rehabilitation therapists with the highest possible technology throughout their treatment process. Our iPhone application RehabCounter, will reduce data collection complexity with immediate distinct progress graphs through which therapists can handle individual patients efficiently. This methodology will minimize the analysis and collection period and thus, the whole treatment session length. RehabCounter is being designed to reduce data collection burdens and allow therapists to obtain a more accurate, empirically driven picture of how well their rehabilitation programs work.

FORWARD THINKING/INNOVATION

The focus of RehabCounter is to simplify the job of rehabilitation therapists in terms of analysis, time, and cost. Incorporating an intuitive and robust data collection interface, RehabCounter allows users to gather data quickly and efficiently. The data collection model with timestamps and tagging of rehabilitation sessions with a particular phase allows therapists to generate insightful graphs automatically that highlight patient performance over time. While designing RehabCounter our first concern was to develop a self-contained evidence-based application that will be highly customizable. Using RehabCounter, therapists can accelerate the decision period by utilizing instantly generated performance graphs over time. While most existing rehabilitation software focuses on guiding patients in performing therapy exercises, our application emphasizes the collection and assessment of accurate therapy session data.

STUDENT INVOLVEMENT

Zerin and Casey are working on design and developing a smartphone-based RehabCounter for Rahabilitation therapists. We are planning to use the CoreData framework for iPhone devices for storage and retrieval of the collected data. We are also planning to integrate mobile phones and web services.

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PROJECT TITLE
Risky Behavior Detection through mHealth for Veterans suffering from PTSD

FACULTY
Sheikh Iqbal Ahamed,
Ph.D., Zeno Franco, Ph.D.
Christina Eldredge, M.D.
STUDENT NAME
Golam Mushih Tanimul Ahsan

INTRODUCTION
Since the Iraq and Afghan war, a lot of veterans are deployed overseas. DoD found out that 20.3% of active and 42.4% of reserve component soldiers required mental health treatment.[1] Mental health issues have become a primary concern for veterans and PTSD (Post Traumatic Stress Disorder) is one of the major mental issues veterans are suffering from. Veterans suffering from PTSD tend to engage in high risk behaviors as drug abuse, alcohol abuse, careless driving, suicide etc. In US, the uses of smartphones have exceeded the uses of other mobile phone devices. All these devices come with different sensors as Accelerometer, Gyroscope, GPS etc. From these devices it is possible to get multimodal data. We plan to develop a model to detect high risk behaviors among veterans with the embedded sensors of a smartphone. We also want to create a dataset to train that model and evaluate our system with the machine learning and existing methods.

SIGNIFICANCE
Mental health illnesses cause a huge amount of expenditures nationally.[2] The veterans are more exposed to traumatic experiences and thus they suffer from PTSD more than the other people. Traumatic combat experiences may lead to very risky behaviors which can affect the surroundings of a veteran and themselves too. Research shows that certain age groups and people living in a certain distances from VA facility are less likely to get treatment. So, the distant monitoring can help a lot. Also using this multimodal procedure, it is easier and less complicated for a veteran to participate in the program. Thus it is effective both medically and economically.

FORWARD THINKING/INNOVATION
There are already some self monitoring systems for PTSD among veterans. But acquiring correct and timely information from these systems is not possible always. There are issues like mistrust, lack of motivation etc. behind this. As smartphones are highly used among different populations now, the devices along with its sensor information can provide a lot of information about the surroundings and the behavior of the bearer. This project will develop a new generation mobile health (mHealth) system to detect risky behaviors among veterans. The system will also be able to communicate with the existing systems. We will develop applications for handheld devices and from the collected data we will model the behaviors.

STUDENT INVOLVEMENT
Golam Mushih Tanimul Ahsan is working on the system design, implementation and evaluation.

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PROJECT TITLE: RSSI based Indoor Localization using Wireless System
FACULTY: Sheikh Iqbal Ahamed
STUDENT: Md Osman Gani, Casey O'Brien, Md Miftah Uddin

INTRODUCTION

Today, with the dispersion of Smartphone's, wireless networks and diverse related services, localization plays very important role. Various location based services (LBS) has been developed using global positioning system (GPS) for outdoor environment and it has a higher rate of accuracy. It is not viable to use GPS based localization in indoor or wireless sensor networks (WSNs) because it is expensive in terms of energy, cost and the signal is not available indoors. Currently, there are several methods for estimating positioning. Three types of measurements are mainly used, 1.Angle of Arrival (AOA), 2.Time of Arrival (TOA) and Time Difference of Arrival (TDOA) and 3.Received Signal Strength Indicators (RSSI). In contrast with AOA, TOA/TDOA, measuring the RSSI value is very much simple and also available in all existing wireless systems. That is why RSSI based methods are preferable and easy to implement [1] [2]. We can consider RSSI as a function of distance. RSSI can changes for various reasons like propagation losses, complex indoor layout, orientation of the source and receiver, line of sight (LOS) requirement and environmental changes. The key complexity is that wireless signals in an indoor environment suffer from interference and attenuation from multi-path fading, reflection, channel fading, deflection, and diffraction [3] [4]. Due to unpredictable behavior of signal, finding location with low error rate is a great challenge. Almost all of the method needs RSSI value, a number of reference nodes, fingerprint database of RSSI values for estimating distance. So these methods require additional cost for the infrastructure. Some methods are adaptive and others need training each time there is a change in environment. Therefore, the goal of this project is to design and develop an infrastructure less intelligent ubiquitous system which will be able to detect the location of the user both indoor and outdoor with a higher accuracy using Wi-Fi technology.

SIGNIFICANCE

Now a day's every Smartphone is equipped with IEEE 802.11 WLAN adapters and a variety of sensor. Use of the Smartphone based system eliminates cost of additional device and sensor. The proposed location detection system has its applicability in a wide range of areas such as child tracking, patients monitoring, assets monitoring and tracking, elderly care, location based services (LBS), anomaly detection on wireless sensor network, safety application in industrial automation, locating underground miners or vehicle, localization of mobile device on a map, customer interest observation in supermarkets or exhibition and many more. It will help to accelerate research in ubiquitous localization using Wi-Fi technology.

FORWARD THINKING / INNOVATION

In this research we proposed a novel infrastructure less localization method using Smartphone to find out the distance and direction of a mobile device in an intelligent approach. The approach of the proposed research exhibit the following novelty and contributions: 1) Establish a new algorithm to model the localization with environmental parameter. 2) Eliminate the requirement additional infrastructure such as reference node, computational device. 3) Smartphone based system which will be cost effective and easy to use. 4) A self adaptive system to estimate environmental parameter i.e. eliminating requirement of training before employment of the system. 5) Improve localization accuracy in a ubiquitous fashion using the help of the existing resource (if is there any). 6) The system will be able to protect any privacy attacks thus aware about the security and privacy of the user.

STUDENT INVOLVEMENT

Md Osman, Casey and Miftah are working on design and development of the proposed system. Md Osman will work on developing data collection tools in Android and iPhone. Casey will work on data analysis and mathematical modeling. Miftah will work on modeling RSSI with environmental parameters.

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PROJECT TITLE
smartPrevention: **Design and Development of a Smartphone-Based Fall Prevention System**
FACULTY
Sheikh Iqbal Ahamed, Ph.D.
STUDENT NAME
AKM Jahangir A. Majumder

INTRODUCTION

Falls in the elderly are a very common occurrence that can have dramatic health consequences. For people over 70-75 years old, the estimated incidence of falls is over 30 percent per year [1]. Nearly half of nursing home patients fall each year, with 40 percent falling more than once [2]. However, it is the impact rather than the occurrence of falls in older adults, which is of most concern. Falls can cause physical injury to people, especially to the elderly, including fractures, head injuries, or serious lacerations. Falls not only cause physical injuries, but also have dramatic psychological consequences that reduce elderly peoples' independence [3]. In addition to the psychological and physical trauma of a fall, incidents can involve various other issues as well: the cost of hospitalization and physical therapy. In this poster, we propose a smartphone-based fall prevention system that can alert the user to their abnormal walking pattern. The smartphones are integrated with two powerful sensors: accelerometer and gyroscopes that are used in our system to identify abnormal gait or walking patterns in elderly. Since abnormal walking patterns can lead to fall, the identification of abnormal gait in our system is used to alert the user regarding a potential fall. We are also developing a low-cost smartshoe with pressure sensors that communicate to a smartphone over WiFi. The addition of the shoe will allow us to identify the specific reasons for walking abnormalities and will help us to increase fall prevention accuracy.

SIGNIFICANCE

In all previous studies, the system can detect a fall only after it has already occurred and the system sends an alarm to the caregivers for immediate help. Even though these fall detection systems are helpful, the best way to reduce the number of falls and their consequences is to prevent them from happening in the first place. We believe that the best way to reduce the number of falls is to alert the users about their abnormal gait/walking and the possibility of falling. The term "gait" refers more specifically to the manner or pattern of walking. Gait and balance disorders are common in older adults and are a major cause of falls in this population. If abnormal walking patterns can be identified using automated processes and with good accuracy, the elderly can be saved from a potential fall. To the best of our knowledge, we are the first to use the built-in accelerometer and gyroscope of the smartphone and smartshoe with foot pressure sensor to identify abnormal gait pattern in users for fall prevention.

FORWARD THINKING/INNOVATION

Smartphone-based fall detection systems can function almost everywhere, since mobile phones are highly portable. The considerable risk of falls and the substantial increase of the elderly population have stimulated scientific research on smartphone-based fall detection systems recently. Even though these systems are helpful for fall detection, the best way to reduce the number of falls and their consequences is to prevent them from happening in the first place. Therefore, our focus is on fall prevention rather than fall detection. To address the issue of fall prevention, in this poster, we propose a smartphone-based fall prevention system that can alert the user about their abnormal walking pattern. Most current systems merely detect a fall whereas our approach attempts to identify high-risk gait patterns and alert the user to save them from an imminent fall. Our system uses a gait analysis approach that couples cycle detection with feature extraction to detect gait abnormality. We conducted experiments on numbers of different users (with different age, heights and genders) carrying a smartphone and showed that our system can identify a potential fall, based on users' gait patterns.

STUDENT INVOLVEMENT

Jahangir is working on design and developing a smartphone-based gait biomechanical model of fall events for fall risk assessment by analyzing the gyroscope and accelerometer data from smartphone and data from foot pressure sensors to prevent the risk of falling.

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PROJECT TITLE
Towards an accurate activity detection system using multiple sensors
FACULTY
Sheikh Iqbal Ahamed, Ph.D.
STUDENT NAME
Ferdaus Ahmed Kawsar

INTRODUCTION

There have been numerous efforts to detect human physical activities. Automatically detecting human activities is important for doctors who want to monitor patients to see how they are doing. Activity recognition system also has uses in interruption management. Human activities and postures are very important context and context information is the most important information in context-sensitive interruption management. Modern Interruption management systems owe their intelligence to their ability to detect appropriate context. Also quantity of physical activity is an important indicator of energy expenditure. Quality and quantity of physical activity indicates the health condition of people. Earlier works on activity detection was cumbersome and mostly experimental. With the introduction of smart phones, unobtrusive activity detection system has been developed [1]. We plan to rebuild these systems so that they can be more accurate.

In our case, we are working on building a system which provides real-time health data to doctors, enabling them to monitor patients remotely and reducing visits to clinics. For our project, we have already developed a cell-phone based remote symptom monitoring system. Our current system provides symptom data to healthcare personnel real time. Earlier we built a cell phone based application which allows patients to submit ESAS information from their cell phones. Doctors can view these data graphically from their cell phones using the same application. This activity detection module we are developing will give the doctors another parameter to monitor. We already showed in our previous works that accelerometer data collected from different activities from a single person can be classified using available classification algorithms. Now we are trying to increase the accuracy of this system using the data from pressure sensors placed on shoes.

SIGNIFICANCE

Our goal is to develop a very accurate activity detection system which we plan to incorporate in our remote monitoring system. In healthcare system, doctors can view patient information from the electronic medical record. The data in EMR, though contains a lot of static information, does not contain any live information. For example, amount of physical activity in last 7 days of a patient is not available in EMR. Our continuous remote monitoring through cell phone will add a new dimension to the current system as doctors now will be able to view continuous live information from patients real-time.

FORWARD THINKING/INNOVATION

Earlier works on activity detection using cell phones have used accelerometer in the cell phones. To make it more accurate, we will use multiple sensors. Along with accelerometers, we will use gyroscope data and data from pressure sensor data from left and right shoe. A pressure sensor system [2] has been built where pressure data from left and right shoe are transmitted to an Android phone over Bluetooth. Our primary experiment with multiple sensors where we combined all four systems using a voting algorithm showed a much better accuracy than any of the single system.

STUDENT INVOLVEMENT

Kawsar already developed a data collection system which collects data from all four sensor system. He also collected and preprocessed the data and primary experiments showed very good accuracy. Now he is working to implement the system in an Android platform.

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PROJECT TITLE

TOWARDS A CELL PHONE-BASED, HOME MONITORING TOOL FOR SCREENING AND TREATMENT
MONITORING OF AUTISM SPECTRUM DISORDER

FACULTY NAMES

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INTRODUCTION

Autism spectrum disorder (ASD) is a collective term for a group of pervasive neurodevelopmental disorders
characterized by repetitive behaviors and atypical development of socialization and communication.[1] According to the
Centers for Disease Control and Prevention, the prevalence of ASD has increased from approximately one in every
2,000 people (0.05%) in the a 1980's to the present day estimate of one in 88 people (>1.0).[2] There is no single risk
factor that explains the change in prevalence over time, and no cure for ASD. Furthermore, early detection is essential
so children can receive evidence-based therapies to improve their chance of optimal functioning.[3]

SIGNIFICANCE

ASDs are typically identified by a medical professional's concern from tracking a child's behavioral pattern and social
and communication skills, in conjunction with a positive result at 18 to 24 months of age on an ASD screening measure,
an example of which is the Modified Checklist for Autism in Toddlers (M-CHAT)[4]. In addition to professionals,
though, parents may also identify concern about delayed or unusual language, limited interactions with others, or the
presence of unusual behaviors during the first three years of life. Although parental concerns about development are
often noted before the age of two years, formal diagnosis of ASD is often delayed to after four years of age.[2]
Accessibility to health care, language barriers, and lack of knowledge about the signs of ASD are barriers to
recommended professional screening and early diagnosis. Once diagnosed, treatment costs can range up to $70,000 a
year per child; nationwide, the expense is $90 billion annually. Furthermore, engaging an adult with ASD in the
national workforce is challenging. Therefore, early detection and intervention can potentially ease the human and
financial cost of ASD. Given knowledge and accessibility barriers, a Mobile based screening (M-CHAT), and symptom
monitoring application (ATEC-Autism Treatment Evaluation Checklist) may play a revolutionary role for early
awareness and ongoing behavior analysis for children with ASD.

FORWARD THINKING / INNOVATION

Screening and follow up for at-risk children in an effective, easily accessible method (via mobile phone: no barriers of
distance or internet connectivity), can assist in early detection and early intervention for ASD. Moreover, the
effectiveness of treatment can be improved, as immediate feedback and fine-tuning of treatment by a trained observer is
possible. Further data collection for future research purposes regarding ASD behavior is an added advantage. The
overall system has the potential to impact the human and financial cost of ASD through early diagnosis, timely
intervention, and enhanced 3-way communication (patients, caregivers and medical professionals).

STUDENT INVOLVEMENT

The students plan to develop a short message service (SMS) based questionnaire for low-end mobile phones. There will
be an SMS server to receive the responder's SMS and inform scores for referral advice and send necessary data to their
interventionists. At the same time, it will have a FAQ section with strategies from experienced medical professionals for
handling challenging behaviors. We believe such a platform is highly needed by the caregivers of children with ASD.

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PROJECT TITLE
Towards a Framework for Physiological Parameter Monitoring Using Smart Phones
FACULTY NAME(S)
Sheikh Iqbal Ahamed, Ph.D.
STUDENT NAME(S)
Mohammad Adibuzzaman

INTRODUCTION

Pulse oxymeter is widely used to monitor vital physiological parameters. Pulse oxymetry is accomplished using the red light and infrared ray absorption properties of oxygenated and deoxygenated blood. The colors of oxygenated and deoxygenated blood vary from bright red to dark red. Using this property, a fingertip video image can be used to obtain data on these physiological parameters that a pulse oxymeter measures. A fingertip, or earlobe video image can also allow a measurement of the pixel density which should be convertible into a red blood cell count.

SIGNIFICANCE

Pulse oxymeter is widely used in hospital environments. The market share for pulse oxymeter is increasing due to the fast growth in developing countries and growth in awareness. The expected market shared for pulse oxymeter is to exceed 500 million dollars [1]. Despite this, it is a significant problem how to measure the vital signs remotely for patients with low income. Availability of smart phones and the ability to measure vital physiological parameters will change the critical care procedure. By analyzing the video signal, and the different combinations of Red, Green and Blue pixel intensity and peak to peak ratios we propose to develop a mathematical model that would compare the video image data to the pulse oxymeter data. Then we can determine the pulse oxymeter measures and red blood cell count.

FORWARD THINKING/INNOVATION

Presently physiological parameters like heart rate, perfusion index and oxygen saturation are measured using a pulse oxymeter. Red blood cell count and hemoglobin levels are currently measured using blood samples obtain by venipuncture from people. Within a machine, the red blood cells are broken down to get the hemoglobin into a solution. The free hemoglobin is exposed to a chemical containing cyanide which binds tightly with the hemoglobin molecule to form cyanomethemoglobin. By shining a light through the solution and measuring how much light is absorbed the amount of hemoglobin is determined. These machines use Coulter Principle, which uses the fact that particles moving in an electric field cause measurable disturbances in that field. The magnitudes of these disturbances are proportional to the size of the particles in the field. For the RBC count we propose to analyze the intensity red pixels for people with different RBCs (using the "gold" standard test) and relate the two measures with an appropriate mathematical model.

STUDENT INVOLVEMENT

Mohammad Adibuzzaman is working on a prototype to do a clinical study for finding a relationship between different signal properties of the video image and vital signs. He is working on using the smartphone to capture physiological information.

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Project Title: Structure and Property Comparison between "Ni-free" and Ni-containing
Stainless Steel Orthodontic Wires

Faculty Name(s): David Berzins, PhD
Student Name(s): Amrita Rakalla, DDS and Amanda Olejniczak, DDS

Introduction
Nickel allergies and sensitivities continue to rise in prevalence throughout the population. Nickel is the most common metal associated with contact dermatitis in orthodontics[1]. Patients previously sensitized to nickel, most frequently due to body piercings, may be more likely to have an allergic response to nickel-containing orthodontic materials.[1] Metal orthodontic brackets and wires are commonly made of stainless steel and other materials that contain nickel, such as nickel-titanium. For example, the austenitic stainless steel used to make orthodontic brackets contains approximately 8 percent nickel.[2] Alternatives to nickel-containing materials in orthodontics include ceramic or resin-based brackets and wires, titanium molybdenum alloy (TMA) wires, and "nickel-free" stainless steel brackets and wires. A study comparing one nickel-free stainless steel wire to conventional stainless steel wires found no difference in elastic modulus, hardness, ductility, and yield strength between the two.[3] Stainless steel is also frequently used for medical applications. Incorporation of nickel-free stainless steel implants within the medical field has been done so successfully.[4,5]

Significance
Nickel sensitivity continues to be a significant health concern. In orthodontics, nickel is readily found in wires, brackets, as well as other critical supplies. For those with nickel allergies, orthodontists are required to find alternative methods for providing adequate treatment. As long as the allergy to nickel remains a worldwide concern, nickel-free alternatives will be a necessity, especially in the field of orthodontics.

Forward Thinking/Innovation
Nickel-free wires and brackets could replace the usual orthodontic supplies for patients with nickel sensitivities or allergies. However, few studies have investigated the characteristics of the nickel-free wires and brackets. It is the goal of the authors to determine how nickel-free stainless steel wire alternatives compare with their nickel-containing counterparts concerning the following: corrosion, 3-point bending and microhardness properties, as well as composition, microstructure, and phase structure.

Student Involvement
Amrita Rakalla, DDS and Amanda Olejniczak, DDS are current orthodontic residents who will participate in this project, leading them to publish in a peer reviewed journal or defend a thesis under the guidance and direction of David Berzins, PhD. The resident's involvement in the design of the study and literature search, analyzing data and writing the review or thesis will be the major source of work for this project. The end result of this process should be a publication in one of the major orthodontic or biomaterial journals.

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PROJECT TITLE: "Facial soft tissue changes associated with rapid palatal expansion"
FACULTY NAME: Jose A. Bosio, DDS, MS, Assistant Professor, MUSoD
STUDENT NAME: Peter Longo, Department of Orthodontics, MUSoD

INTRODUCTION

Rapid palatal expansion (RPE) is frequently indicated to expand constricted maxillary arches, to increase dental arch width, and to correct posterior cross bite. The mechanism is relatively non-invasive, and it works by orthopedic expansion of the midpalatal suture as well as buccal rotational force on the maxillary alveolar shelves.[1,2,3] The forces produced on the midpalatal suture range from 15 to 50 Newtons, allowing primarily orthopedic movement and minimizing orthodontic tooth movement (OTM)[4,5]. Although numerous studies have examined the dental and hard tissue changes, few reports have addressed the facial soft tissues alterations. The goal of this project is to determine the changes in facial soft tissue structures measured with a digital caliper before and after palatal expansion.

SIGNIFICANCE

Few studies have reported the overall effect of rapid maxillary expansion on facial soft tissue landmarks. A sample of approximately 30 MUSoD patients and possibly an age and gender match control sample will be measured before and 30 days following palatal expansion using a high precision digital caliper (the control sample will have no treatment). Mouth width, base of the nose, alar of the nose, intercanthal distance and other changes will be evaluated. All subjects will consent to volunteer for this study. The outcome of this study will aid orthodontic practitioners, as well as patients, in better understanding what facial soft tissue changes, as well as degree of change, may occur during palatal expansion.

FORWARD THINKING / INNOVATION

Facial changes before and after palatal expansion have been observed by clinicians, but not specifically quantified. Most studies have reported on skeletal and dental changes before and after palatal expansion. This study will use a simple and inexpensive digital caliper method to acquire facial measurements. The results will focus on the transverse and vertical changes observed after palatal expansion. At the completion of the study, clinicians will have a better understanding and will be able to better quantify specific changes to the soft tissue of the face.

STUDENT INVOLVEMENT

The graduate student will be responsible to write the research proposal, and possibly ensemble and measure the match control sample, as well as organize and analyze data from the study sample. He will also review the literature, write the material and methods, results, discussion and conclusion. This work will generate a Master Thesis in the orthodontic department and, ultimately, it will be published in some relevant orthodontic journal.

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Project Title: Blending as a Multi-horizon time series forecasting tool

Faculty Name:
Ronald H. Brown, Phd, Associate Professor, Electrical & Computer Engineering
George F. Corliss, Phd, Professor, Electrical & Computer Engineering

Student Name:
Tian Gao, Electrical & Computer Engineering graduate student

Introduction
With the increasing demand for gas, it becomes more and more important for the local distribution companies (LDCs) to get an accurate forecast of the consumption of the gas used by their customers every day. Accurate forecasting cannot only save money, but also contribute to saving energy and protecting the environment. GasHour from GasDay^{TM} , as an hourly gas consumption forecasting tool, can produce forecasts up to 106 hours ahead. These forecasts use no ensembling, and mainly rely on multi-horizon forecasting for accuracy. GasHour has a very good performance. However, things can be done to improve its performance.

Problem Statement
The problem is maximizing the accuracy of gas consumption forecasts based on current GasHour forecasts. In other words, the goal to achieve here is to minimize the error metrics, such as RMSE or MAPE.

Method
To obtain an accurate forecast, good models need to be constructed. To create these models, clean and abundant data are necessary for training these models. Other work is being done in improving the quality of data and building new models to increase the accuracy of forecasting. However, in the approach presented below, combining methods will be the primary ways to improve forecast results. In other words, the strategy used here emphasizes finding interconnection between each current forecast, as suggested by Armstrong's advice for ensemble forecasting and using polynomial smoothing, filtering, or Artificial Neural Networks to combine these forecast (blending). GasHour produces multi-horizon forecasts for up to 106 hours ahead. Among all these forecasts, there exists a possibility that one of them has some kind of relationship with the others around it. This suggests combining neighboring forecasts.

PROJECT TITLE: "Porting XINU to Raspberry Pi"
FACULTY ADVISOR: Dr Dennis Brylow, Professor, MSCS
STUDENTS: Matthew Bajzek, Undergraduate Research Assistant, COEN & COSC
Farzeen Harunani, Undergraduate Research Assistant, COEN & COSC
Tyler Much, Undergraduate Research Assistant, COSC & MATH

INTRODUCTION

As the field of computer science expands and becomes increasingly more complicated, two things happen. First, hardware and software get outdated regularly, and staying "up to date" can be expensive. Second, in terms of teaching computer science, it can be difficult for newcomers to the field (mainly students) to grasp the underlying concepts due to modern computing's ever-increasing system complexity. By merging an inexpensive piece of hardware with a simple Unix-like operating system, we can create a teaching tool that is accessible to anyone—in terms of usability as well as monetary cost. This project proposes to utilize the XINU operating system in conjunction with the Raspberry Pi development board to achieve this goal.

SIGNIFICANCE

For many schools, a stable, simple, inexpensive environment on which to teach basic operating systems concepts is almost impossible to find. XINU (XINU Is Not Unix – a recursive acronym) is a small, academic operating system first developed at Purdue in the 1980s to solve just this problem. It is written in standard C, and has implementations of all basic operating system functionality, such as semaphores, interprocess communication, a simple shell interface, and networking.

However, it is not enough to just have an environment to work in—hardware is also needed, and that is where Raspberry Pi comes in. At $35 or less per computer, it meets the qualification of being inexpensive, but has enough power to run memory and processor-intensive applications, such as Quake III—and therefore certainly enough to run XINU, a notoriously lightweight operating system.

FORWARD THINKING/INNOVATION

The approach is straightforward: layer by layer, from the ground up, to build a fresh operating system for a relatively new device. The first step will be to flush the device clean, and get the device to "speak" directly to us, with no operating system in between. Only after that will we be able to begin to adapt the XINU software for the Raspberry Pi.

The approach is also novel: nobody has done this before. The device was released earlier this year, and Marquette University remains the leader of XINU development. Though many schools have adopted XINU as a teaching tool, most schools continue to rely on the few schools like Marquette that persist in optimizing XINU for newer hardware for development. Raspberry Pi is a logical fit for XINU, and Marquette University is the logical home for this merger to take place.

This project is no small undertaking, and we know that going in. There is little documentation to work with and a lot of work to do. However, after the completion of this project, budding computer scientists and engineers will be able to have a simpler, better starting point from which to launch their careers. Students who will have access to the XinuPi will have an inexpensive device to work with and software that is understandable, rather than intimidating and complicated.

STUDENT INVOLVEMENT

This project is designed to be built by students for students. Matthew Bajzek, Farzeen Harunani, and Tyler Much plan to take the lead on this project, with mentoring and advising from Dr Dennis Brylow. Mr Bajzek, Ms Harunani, and Mr Much will optimize XINU for the Raspberry Pi, so that, in the future, other universities may benefit from this research as well.

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POSTER TITLE: What Do Family Caregivers Know About Delirium?
FACULTY NAMES: Margaret Bull, PhD, RN and Lesley Boaz, PhD, RN, GNP, FNP
STUDENT NAME: Jennifer Sjostedt, MSN, GNP, RN, Nursing Doctoral Student

INTRODUCTION

Delirium is a common, life threatening, frequently reversible condition.[1] Older adults who have dementia are more likely to develop delirium.[2] Older adults often develop delirium as a sign of illness rather than fever or other symptoms typical in younger adults. [1]Family caregivers might misinterpret delirium symptoms as progression of dementia or normal aging. Delirium symptoms include sudden onset of confusion, problems with memory, excessive drowsiness, difficulty concentrating and communicating.[1] Unlike dementia in which mental status changes occur gradually over time, symptoms of delirium occur suddenly over a few hours or days. Failure to recognize delirium early contributes to poor outcomes for older adults; mortality increases by 11% for every 48 hours of delirium.[3] Delirium also increases the older adult's risk of falls, and leads to a cascade of functional decline, lengthy hospital stays and institutionalization.[3-5] Estimated costs of delirium for the US health care system range from $38 to $152 billion annually with higher costs associated with delirium superimposed on dementia (DSD).[5] More than 75% of older adults with dementia are cared for by family members. Although family caregivers who know the usual behaviors of the older adult with dementia are most likely to recognize changes in mental status, delirium symptoms are often misinterpreted as progression of the dementia or normal aging.[6,7] Consequently it is vital to find out what family caregivers know about delirium to design effective educational interventions.

SIGNIFICANCE

Often delirium is not recognized, thereby delaying diagnosis and treatment of the underlying cause.[6-7] Early identification of delirium is critical to improve health outcomes for older adults who have DSD. Family caregivers can be vital partners in the identification process. The aims of this study are to: 1) identify what family caregivers know about delirium, 2) describe their preferred ways to receive delirium information, and 3) examine the psychometric properties of a delirium knowledge questionnaire for family caregivers. Learning what family caregivers know about delirium and their preferred ways of receiving information is a vital first step in designing effective interventions to increase family caregivers' knowledge of delirium and improve health outcomes for older adults with DSD.

FORWARD THINKING/INNOVATION

This study is innovative in developing a delirium knowledge questionnaire specifically for family caregivers. A valid, reliable measure of family caregivers' knowledge about delirium does not exist in published literature. Systematically assessing family caregivers' knowledge of delirium and their preferred ways of receiving information is foundational to design effective educational interventions for them. Little attention has been given to educating family caregivers about delirium, yet preparing them to partner in early identification of delirium might improve health outcomes for older adults with DSD.

STUDENT INVOLVEMENT

PhD student, Jennifer Sjostedt, MSN, GNP, assisted Drs. Bull and Boaz with the literature search and development of the delirium knowledge questionnaire. Ms. Sjostedt also will assist with the data analysis which will include descriptive statistics and inferential statistics to examine psychometrics of the delirium knowledge questionnaire. In addition an undergraduate student will be engaged to assist with the sampling and mailing the surveys.

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Project Title: The Co-Principalship - A Leadership Model for the Future?
Faculty Name(s): Ellen Eckman, PhD, Associate Professor, Chair, College of Education
Student Name(s): Amy Porter, Educational Policy and Foundations Master's Student

Introduction

The position of school principal is a complex and demanding one because "today's principal must be a legal expert, health and social services coordinator, fundraiser, public relations consultant, parental involvement expert, and security officer, who is technologically savvy, diplomatic, with top-notch managerial skills, whose most important duty is the implementation of instructional programs, curricula, pedagogical practice, and assessment models"[1]. The co-principalship, which is based on a shared leadership model, has been suggested as an alternative to the traditional solo position. The co-principal model has the potential to increase the effectiveness, job satisfaction and overall attractiveness of the role of principal/leader of a school.

This research project is designed to examine the implementation of the co-principalship model in a single school district in three school buildings. The questions being investigated are: (1) What are the problems and challenges associated with implementing a co-principalship? and (2) How does this model impact job satisfaction for the co-principals and teachers? Data will be collected using surveys, interviews and focus groups. All the teachers in the district will be surveyed; the six co-principals will be interviewed several times; and focus groups of teachers will be held at each of the school buildings.

Significance

The traditional principal is a solo decision maker who is isolated and alone at the top of the hierarchical organizational structure - a person who is "apart from others" and "lonely at the top"[2]. Principals find themselves overwhelmed by the increasing workload, expectations, and demands of the position. For many principals, meeting this workload intensification has led to increased conflicts between their personal and professional lives, as well as with decreased levels of job satisfaction[3,4]. The work demands and role conflicts have made the position of principal less attractive as a career. This is not the case for co-principals. Dr. Eckman's previous research has shown that co-principals experience a greater degree of job satisfaction than do traditional principals and are able to balance their personal and professional roles in a meaningful way. Similarly, co-principals are more available to their teachers, students and parents[5,6].

Forward Thinking/Innovation

The idea of looking beyond the traditional model of the solo leader has been proposed and practiced in the business community; "co-leadership is not a fuzzy-minded buzzword designed to make non-CEOs feel better about themselves and their workplaces... In this new organizational galaxy, power doesn't reside in a single person. Rather power and responsibility are dispersed"[7]. Recently, the *Chronicle of Higher Education* reported on the use of two presidents with equal and shared power to lead higher education institutions as a way to address "the vexing reality that a college president cannot be in two places at once"[8]. A shared leadership model, in the form of a co-principalship, has the potential to revolutionize the organizational structure of schools in ways that will benefit teachers, students and parents.

Student Involvement

Ms. Amy Porter will have direct input in this research project through her support and collaboration with Dr. Ellen Eckman. Ms. Porter will handle the distribution and analysis of surveys as well as participate in and transcribe all the interviews and focus groups. Dr. Eckman and Ms. Porter will systematically code and analyze all the data with the intent of co-authoring a manuscript.

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Project Title: *Efficacy of Helping Sub-fertile Couples Achieve Pregnancy with Focused Intercourse during the Fertile Window*

Faculty: Richard J. Fehring, PhD, RN, FNI, FAAN
Student: Qiyan Mu, BSN, RN

Introduction

Couples in the United States and other Western nations are delaying marriage and postponing having children for the purpose of developing careers and stabilizing relationships. The risk of delaying childbirth to an older age is a diminished fertility and the potential expense of infertility diagnosis and treatment. Demographic studies have shown that there is a consistent decline in fecundity with advancing age after 30-35 years. Recent studies have suggested that older women (i.e., 30 years or older) should be referred for an infertility workup after only 6 months of trying to achieve pregnancy (8-9). However, before engaging in expensive diagnosis and treatment for infertility, there are less expensive self-directed methods that have been shown to optimize fertility.

Significance

There are about 7.2 million U.S. women of reproductive age with infertility problems, this represents up to 1 out of 6 couples of reproductive age. Of these couples, about 20% or 1.2 million have un-explained infertility. Many of these couples may be able to achieve pregnancy with low cost behavioral means and with professional nursing support. However, there is a lack of good evidence for simple behavioral means to optimize fertility and access to professional nurse fertility consultants who specialize in helping couples to achieve pregnancy. The Internet is an important source for couples who want to have a child, but don't have access to appropriate health professionals.

Forward Thinking Innovation

There are only 6 days during the menstrual cycle in which there is a probability of pregnancy with an act of intercourse, i.e., the day of ovulation and the preceding 5 days. These days are known as the fertile window (FW). There is evidence that couples desiring pregnancy often mistime intercourse when trying to achieve pregnancy and lack knowledge of the FW. The purposes of this current study and future studies will be to determine pregnancy rates among couples focusing intercourse during the self-estimated FW and to compare pregnancy rates when couples have random acts of intercourse. We are also interested in the use of a new fertility monitoring app for smart phone devices. The smart phone fertility app will be linked to a fertility health internet site that provides online fertility charting and advice and support by professional nurses.

Student Involvement

Qiyan Mu (first year PhD student) will be developing and testing behavioral interventions to help sub-fertile couples, i.e., those 35 years and older, achieve pregnancy as part of her ongoing research that will lead to her dissertation. She will be working with graduate students in the department of mathematics, statistics, and computer science (MSCS) in the development and testing of a fertility app and fertility support web site (currently Mifta Uddin). Professors Richard Fehring (College of Nursing) and Sheikh Ahamed (MSCS) will be directing and advising these students in this interdisciplinary process.

PROJECT TITLE

Natural Family Planning With Mobile Computing

FACULTY

Richard Fehring, Ph.D., Sheikh Iqbal Ahamed, Ph.D., and Mary Schneider

STUDENT NAME

Md. Miftah Uddin

INTRODUCTION

Family Planning is an important part of happy conjugal life. Natural Family Planning (NFP) is the way of monitoring biological parameters through a menstrual cycle with couple's intension of avoiding or achieving pregnancy. Monitoring menstrual cycle is also an important indicator of women's health. Natural Family Planning has been practiced in society from ancient time because of its moral-ethical values and cultural acceptance. The Institute of Nursing of Marquette University has developed a model of natural family planning which overcomes the variability of the biological parameters and gives it a new dimension [1]. To ensure the widespread availability of the system we plan to develop a mobile based system that completely adhere the features of Natural Family Planning. As a first step we have developed a website where user can monitor their menstrual cycle and iPhone application that communicates with the same server.

SIGNIFICANCE

A successful implementation of the mobile based NFP system will ensure the family planning issues along with creating a better bonding in conjugal life and spiritual happiness. The mobile based implementation makes it easier for the users to use the system in their everyday life. With the new integration of social media, it promises to reach every corner of society. The targeted instant notification system will make the users more active and the instant feedback to the health specialists will complete the cycle of caring.

FORWARD THINKING/INNOVATION

It is important to make the apps available for all kinds of people regardless of their economic status. To ensure this, we first developed online menstrual cycle monitoring. In the internet based system the users follow their menstrual cycle by entering biological parameters in charts [2]. From the user experience we found that a mobile based system of cycle monitoring is needed. Therefore we have started developing a mobile based system to give users anytime access, timely communication, instant notification and more interactive user interface. The mobile based system is able to provide continuous communication with health specialist and instant notification based on user intention at the same time. We target to develop a large community of users by incorporating social networking which will be a unique feature of our mobile based NFP.

STUDENT INVOLVEMENT

Md Miftah Uddin is working on the system framework, design, implementation, and evaluating its performance.

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PROJECT TITLE: Latino Adolescent Mental Health: Acculturation Differences and Family Processes
FACULTY NAME: Alyson Gerdes, PhD, Associate Professor, Psychology
STUDENT NAMES: Kathryn Lawton, M.S. and Theresa Lauer, Clinical Psychology Doctoral Students

INTRODUCTION

Although Latino youth are estimated to have higher rates of mental health difficulties than their Caucasian counterparts (Dominguez de Ramirez & Shapiro, 2005; U.S. Department of Health and Human Services, 2001; Yeh et al., 2003), research suggests that their families often do not receive the services they need, and when they do, they are more likely to prematurely drop out of treatment (Kataoka et al., 2002; Garland et al., 2005). Research suggests that this increased risk is likely due to the interaction of many factors, including environmental factors (e.g., acculturative stress and discrimination), as well as acculturation differences within the family and general family functioning (Hwang & Wood, 2006; Smokowski et al., 2006). Thus, in an effort to improve the current mental health disparities that exist for Latino families and to target the above risk factors, the last decade has seen an increased emphasis on the need for culturally-sensitive mental health interventions for ethnic minority children and their families (e.g., Sue, 1998).

SIGNIFICANCE

One area of work has focused on the role of acculturation in mental health difficulties faced by Latino youth and their families. Current acculturation research has demonstrated a direct link between acculturation and mental health outcomes in teens, including both externalizing (e.g., delinquency) and internalizing (e.g., depression) problems (Araujo et al., 2008; Buriel et al., 1982; Ebin et al., 2000; Gowen et al., 1999; Lorenzo-Blanco et al., 2011; McQueen et al., 2003; Samaniego & Gonzalez, 1999). It also has been theorized that normative family struggles that often occur during adolescence may be exacerbated by generational acculturation differences within immigrant families (Szapocznik et al., 1984). Several studies examining acculturation conflict, family functioning, and teen mental health have supported this theory (Hwang & Wood, 1996; Smokowski et al., 2006; Smokowski et al., 2006). Because acculturation has been linked to a variety of negative outcomes in teens, it is important to understand its direct effects and indirect effects, such as through familial processes, in order to develop culturally-appropriate interventions. Thus, the primary aim of the current project is to examine the relation among acculturation differences between teens and parents, family functioning, and mental health in Latino families. This is an important area in need of further research, as it may suggest that directly targeting acculturation processes and possible acculturation differences between teens and parents is needed for positive mental health outcomes in the rapidly growing Latino population.

FORWARD THINKING/INNOVATION

This study will add to the literature in several ways. First, a multidimensional approach to measuring acculturation will be utilized. Specifically, acculturation will be measured using behavioral and cognitive acculturation scales, which will address many issues with the current literature by providing a more complete conceptualization than commonly used proxy measures of acculturation, such as language use. In addition, no studies to date have examined the effect of acculturation differences and family processes on the mental health of parents; thus, this study will be the first to do so.

STUDENT INVOLVEMENT

The development of this project is the result of collaboration between Dr. Gerdes and Katie Lawton. Katie Lawton, with the help of Theresa Lauer, will be responsible for the recruitment of participants from bilingual schools, data entry and verification, and preliminary data analysis. Subsequent publications from this data will be co-authored by Dr. Gerdes, Katie Lawton, and Theresa Lauer.

Project Title: "Transient moods and interpretation bias: Do cognitive reappraisal strategies change both mood and behavior?"
Faculty Name: Nakia S. Gordon, PhD
Student Name: Katherine Reiter, B.A.

Introduction:

Emotion regulation allows us to manage our emotions in response to a wide variety of stimuli and is often used to satisfy social demands in different situations. Additionally, emotions influence how individuals interpret ambiguous stimuli[2]. Research has shown that individuals who were either in an angry or anxious mood were more likely to interpret ambiguous stimuli as threatening compared to those in a happy or neutral mood[3]. Through understanding the presence of interpretation bias to ambiguous stimuli, both before and after emotion regulation strategies, we can ascertain the efficacy of such strategies on decision-making.

Significance:

Individuals who engage in emotion regulation strategies have been found to experience better psychological health and report fewer depressive symptoms and more adaptive social adjustment than those who do not engage in healthy emotion regulation strategies[4]. Given that resolving ambiguous stimuli is influenced by mood, it is important to know the role of emotion regulation strategies in this process. Manipulating these variables will help us better understand the role of emotion in decision-making.

Forward Thinking/Innovation:

The current study is innovative in combining the concepts of emotion regulation and behavior to understand the interplay. Currently, literature examines emotion regulation strategies and their influence on mood states. Separately, researchers examine the resolution of ambiguity in specific moods states[2], thus affecting behavior. However, current literature has not examined these constructs together, thus limiting our understanding of the effects of emotion regulation on implicit facets of transient mood states. In studying this dynamic construct, we can better understand the impact of emotion regulation strategies on both mood and behavior.

Student Involvement:

Katherine Reiter will take the lead on this project. She will recruit participants (N=34) through the human subjects pool and analyze pilot data. Additionally, she will design the experiment with the help of Dr. Gordon. Ms. Reiter is currently a student in the Clinical Psychology doctoral program. This study will be Ms. Reiter's master's thesis.

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PROJECT TITLE: "Bone tissue mechanics in osteogenesis imperfecta"
FACULTY NAMES
Carolyne Albert, PhD, Postdoctoral Fellow, Orthopaedic and Rehabilitation Engineering Center (OREC);
Gerald Harris, PhD, PE, Professor of Biomedical Engineering and Director of OREC
STUDENT NAMES:
Camilla Malowanski, Biomedical Engineering Undergraduate Student;
and John Jameson BS, Biomedical Engineering Doctoral Student

INTRODUCTION

Osteogenesis imperfecta (OI) is a genetic disorder affecting type I collagen synthesis and assembly within bones and other tissues. OI is characterized by bone fragility, and is often correlated with an increase in bone fractures. This fragility is believed to be the combined result of structural deficiency, specifically low bone mass [1], and compromised bone material properties due to collagen and mineral abnormalities [2,3]. Little data, however, is available regarding the material properties of bone tissue in OI, and the contribution of material properties to the bone fragility is not well understood.

SIGNIFICANCE

Knowledge of OI bone material properties, including elastic modulus, strength and toughness, would advance the understanding of bone fragility in OI. This information can aid in the development of finite element models that use an estimated stress distribution within large bones to predict the fracture risk associated with daily activities for individuals with OI. Such models can also be useful in the development of improved rehabilitative strategies that aim to reduce fracture risk.

FORWARD THINKING/INNOVATION

This study will provide the first measurements of bone material strength, toughness, and three-dimensional cortical bone microstructure in OI. Previous characterization studies of bone properties in OI were limited to the measurement of elastic modulus at the sub-microstructural scale using nanoindentation, which does not take into account the substantial cortical bone porosity observed in OI. The current study uses small pediatric osteotomy specimens obtained during routine orthopaedic surgeries performed at Shriners Hospitals for Children – Chicago to measure bone material properties at the mesoscale, taking into account the presence of cortical porosity. The harvested bone specimens will be machined into miniature beams (5 mm x 1 mm x 650 microns) and subjected to three-point bending tests using a flexural test method that was designed and validated specifically to enable mechanical characterization of small bone specimens, such as the osteotomy specimens harvested for this study [4]. Finally, high-resolution synchrotron radiation-based micro-computed tomography will be used to assess three-dimensional bone microstructure, and relationships will be examined between the measured flexural properties and structural parameters such as porosity.

STUDENT INVOLVEMENT

John Jameson will lead the imaging component of this study, as part of his doctoral dissertation, and Camilla Malowanski will assist with analysis of mechanical data.

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PROJECT TITLE: Rehabilitation Articulatory Speech Synthesizer
FACULTY NAMES: Dr. Michael T. Johnson, EECE and Dr. Jeffrey Berry, SPPA
STUDENT NAME: Xiangyu Zhou, MS candidate, EECE

INTRODUCTION and SIGNIFICANCE

The RASS system is a clinical and research system that collects real-time movements of a subject's speech articulators (tongue, lips, and jaw) during speech and provides customized auditory feedback to the subject, in order to measure how this auditory feedback affects speech production. Movement data is collected using an NDI (Northern Digital Incorporated) Electromagnetic Articulography (EMA) Wave system which registers the positions and orientations of small sensors attached to the tongue, lips, and jaw. The RASS system interfaces to the Wave system, calculates acoustic parameters of the sound, and then adjusts these parameters as directed by the experimenter and uses articulatory speech synthesis to generate the auditory feedback. The underlying goals of this research are to investigate and develop new methods for speech therapy in individuals with motor speech disorders.

INNOVATION

The current focus of the research is the time-delay, configurability and usability of the RASS system. The development platform is Microsoft Visual Studio 2008, with some post-processing and support tools in Matlab and S-Plus. Specific goals include:

- Reduce the net system delay between articulator movement and acoustic feedback. The current system has a delay in the neighborhood of 50-60ms, with a target of 30ms based on the underlying hardware delays.
- Increase the usability of the system by redesigning the configuration and setup tools to reduce the number of interactive steps required. The target is to make the system useable by undergraduate research assistants in Speech and Language Pathology with only minimal technical training.
- Add time-stamping for improved synchronization between the movement data and the acoustic input data from the subject. The target is to make time-stamps accurate within 10ms.
- Extend the EMA calibration and head-correction algorithms, which adjusts the articulator data for movement of the subject's head during data collection, to accurately correct both position and orientation data. (The current system only corrects position data.)

STUDENT INVOLVEMENT

EECE MS candidate Xiangyu Zhou will be responsible for this project with the support of Dr.'s Johnson and Berry. Xiangyu will improve the current RASS system based on the above project goals.

PROJECT TITLE:　　"Speaker independent acoustic to articulatory inversion"
FACULTY NAMES:　Dr. Michael T. Johnson, EECE and Dr. Jeffrey Berry, SPPA
STUDENT NAME:　　An Ji, PhD candidate, EECE

INTRODUCTION

SIGNIFICANCE

Human speech is generated through the movement of a complex set of articulators including the tongue, jaw and lips, controlled together through the speech production process. Prediction of articulatory movement from acoustics is difficult but valuable. Articulatory information can be useful for speech synthesis, speech therapy, language acquisition, speech visualization and many other tasks. One important example is Computer Aided Language Learning (CALL) systems where reliable estimates of articulatory movements can help analyze pronunciation error and assist in providing accurate corrective feedback. Current CALL systems are limited in providing such detailed feedback, partially because this problem is difficult and not yet well solved.

While there has been significant prior work in articulator-to-acoustic modeling, with some good results, current methods are speaker specific and require training on articulatory kinematic data. This is not possible in applications such as CALL where speaker independent models would be essential. The complexities of inter-speaker differences in both articulatory and acoustic spaces result in the need to develop more sophisticated methods for normalization of multiple speakers' articulatory measurements to represent a single generalized articulatory space, for creation of speaker dependent acoustic-articulatory models, and subsequently for adapting these models to provide accurate acoustic-articulatory estimation for new speakers for whom there is acoustic but no kinematic data.

The work proposed here addresses the above research problems with the goal of creating a speaker independent articulatory-acoustic estimation algorithm. To do this, kinematic acoustic data for both Native English speakers and Mandarin Speaker will be collected, in collaboration with the current NSF funded "Acoustic-Articulator Modeling for Pronunciation Analysis" project, new methods for articulatory normalization will be implemented in order to reduce the geometrical differences in vocal tract, and a new method for speaker independent acoustic-articulatory mapping will be developed. This method, called parallel reference speaker weighting (PRSW), will be implemented and evaluated on the measured articulatory data and compared across the two speaker groups.

INNOVATION

Current approaches for estimating articulatory parameters are speaker-dependent, requiring matched kinematic and acoustic data for the specific target speaker. Developing speaker independent methods for speech inversion is essential to furthering research in this area. The objective of this research is to extend current methods for acoustic-articulatory inversion to work in a speaker independent domain. Successful achievement of this objective will require advances in techniques for articulator space normalization and for application of current methods for speaker adaption to the problem of acoustic-articulatory inversion. Accomplishing this will enable new methods for comparing complex articulator patterns and assessing first and second language speakers' pronunciation differences and therefore develop more comprehensive and effective feedback mechanisms in CALL systems for pronunciation modification.

STUDENT INVOLVEMENT

EECE PhD candidate An Ji will take responsibility for this project with the support of Dr. Johnson. An's dissertation focuses on building a speaker independent acoustic to articulatory inversion model. This project is a good fit with her dissertation topic and will help her develop a more accurate articulator model across different group of speakers.

PROJECT TITLE: "Direct effect of mechanical vibration on bone resorption *in vitro*"
FACULTY NAME: Dawei Liu, DDS MS PhD, Associate Professor, Dentistry; Rishikesh Kulkarni, PhD, Post-Doc Fellow
STUDENT NAME: Luisa Campos, D3 dental student

INTRODUCTION
Osteoporosis is the most common type of bone disease in which bone resorption overpowers bone formation, leading to net bone loss. Bisphosphonates have been effectively used to treat osteoporosis by targeting on osteoclast formation and function, however its side-effect e.g. osteonecrosis of jaw needs to be paid attention[1]. Non-pharmaceutically, whole body vibration has been suggested to alleviate the loss of bone mass[2]. Mechanistically, osteoclastogenesis and resorption have recently been shown to be regulated via osteocytes in response to vibration[3], however whether vibration directly regulates the formation and function of osteoclasts is yet unknown. Therefore, the aim of our study is to investigate the direct effect of vibration on osteoclast formation and function.

SIGNIFICANCE
The direct effect of vibration on osteoclast formation and function is unknown. Obviously, lack of this knowledge will prevent us from optimizing the whole body vibration as a powerful non-pharmaceutical therapy. Therefore, the direct effect of vibration on osteoclast formation and function will be studied as follows. RAW264.7 (a murine osteoclast precursor cell line) cells will be seeded at 4×10^5/well in 6-well plates (Day 0). To induce osteoclast formation, 20ng/ml RANKL (R&D system) will be added. After overnight seeding, the cells will be subjected to mechanical vibration (20μm displacement, 4Hz) or kept under static culture condition. After 1 hour of vibration, the cells will be kept under normal culture conditions for 5 days. Culture medium will be refreshed after two days. On day 5, the cells will be fixed and stained for an osteoclast marker, tartrate-resistant acid phosphatase (TRACP). The TRACP positive multinucleated osteoclasts will be counted, followed by one-way ANOVA statistical analysis ($P<0.05$ is considered significant).
To assess osteoclast activity, RAW264.7 cells will be seeded on a synthetic calcium-phosphate surface in the presence of 20ng/ml RANKL, and mechanically vibrated (20μm displacement, 4Hz). Culture medium will be refreshed after two days. After 5 days of culture, cells will be removed with bleach and the surface will be treated with von Kossa staining. Resorbed areas will be identified as regions that do not stain for von kossa, and will be imaged under microscope (200x magnification). The resorption area / total surface area will be calculated, followed by one-way ANOVA statistical analysis ($P<0.05$ is considered significant).

FORWARD THINKING/INNOVATION
To the best of our knowledge, we are the first to study the direct effect of vibration on osteoclast formation and function. This project aims to uncover the direct effect of vibration on bone resorption and provide us an opportunity for us to optimize vibration, the non-pharmaceutical means to treat osteoporosis.

STUDENT INVOLVEMENT Luisa Campos (a D3 dental student) will fully participate in this project. She will completely be involved in designing and implementing experiments, analyzing data and writing research paper.

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PROJECT TITLE: "Effect of mechanical vibration on the sliding resistance in fixed orthodontic appliance system"
FACULTY NAME: Dawei Liu, DDS MS PhD, Associate Professor, Dentistry
STUDENT NAME: David Kennedy, 1st year orthodontic resident

INTRODUCTION

The long duration of orthodontic treatment causes side effects such as root resorption, enamel decalcification and compromised patient compliance, to name a few. Shortening the treatment time can greatly benefit both patients and doctors. Experimentally, mechanical vibration has been shown to be able to help move teeth faster in animals[1-2], yet its mechanism is unknown. As a new technology, AcceleDent (commercial name, manufactured by OrthoAccele Inc.), a FDA proved Class II medical device, has been introduced to help move teeth faster in orthodontics. When the fixed orthodontic appliance is used, it is unavoidable to encounter "friction" and "binding", two factors controlling the resistance of sliding teeth along the arch wire. While the vibration's direct effects on the remodeling of periodontium (cementum, periodontal ligament, alveolar bone) are being investigated, little attention is paid to its effect on the mechanic system (wire-ligature-bracket) of the fixed appliance system. Therefore, the aim of our study is to explore the direct effect of vibration on the sliding resistance i.e. friction and binding of the commonly used fixed orthodontic appliance system.

SIGNIFICANCE

One of the theories behind mechanical vibration of teeth is that it reduces friction at the bracket-wire interface, which allows the teeth to slide along the wires. This reduction in friction is said to result in the teeth moving faster along the wires and thus reducing treatment time[3]. There is much debate in the orthodontic community about the role that vibration plays in reducing friction[4]. Although it has been shown that certain types of vibrations occur in the mouth during regular daily activities (such as chewing gum), the effects of introducing higher frequency mechanical vibrations need to be explored. Lack of the knowledge of this will prevent us from applying vibration to enhance orthodontic tooth movement.

FORWARD THINKING/INNOVATION

There have been very few studies testing the effects of mechanical vibration on the friction of wires. Our study design and data analysis will allow us to determine the effects of mechanical vibration on sliding mechanics of orthodontic wires. The results of this study will shed light on the clinical application of dental vibrators and the reasoning behind their success.

STUDENT INVOLVEMENT

1st year orthodontic resident David Kennedy will be engaged in formulating sound study design and carrying out the laboratory experiments. He will be seeking guidance from his advisors, and also from experienced clinicians to get the best attainable results.

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PROJECT TITLE: "Synergistic effect of mechanical vibration and fluid shear stress on osteocytes *in vitro*"
FACULTY NAME: Dawei Liu, DDS MS PhD, Associate Professor, Dentistry; Rishikesh Kulkarni, PhD, Post-Doc Fellow
STUDENT NAME: Matthew Bernard, a junior pre-dental student

INTRODUCTION
Metabolic bone diseases e.g. osteoporosis is largely determined by the rate of bone remodeling (turnover) - a coupled process of bone formation and bone resorption. Mechanical loading has been shown to be able to generate new bone *in vivo* and *in vitro*[1]. Mechanistically, osteocytes, the most abundant bone cells actively respond to fluid shear stress (FSS) in the lacuna-canaliculi system and in turn maintain bone homeostasis through orchestrating formation and resorption phases[2]. Recently, whole body vibration has been shown to have an anabolic effect on bone mass[3] and affects osteocytes *in vitro*[4]. However, little is known about the possible synergistic effect of FSS and vibration on osteocytes. Lack of this knowledge might prevent us from understanding the mechanism of the effect of vibration on osteocytes, and how to optimize vibration to enhance the anabolic response of osteocytes to FSS. Therefore, the aim of our study is to investigate the possible synergistic effect of vibration and FSS on osteocytes.

SIGNIFICANCE
The newly cloned osteocytes cell line – IDG-3SW (from Dr. Bonewald, UMKC) will be used in this study, with its unique feature of expressing sclerostin - a negative bone formation regulator. The synergistic effect of vibration on the FSS induced anabolic response of osteocytes is unknown, which prevents us from optimizing the whole body vibration as a powerful non-pharmaceutical therapy to treat osteoporosis. Therefore, the possible synergy of FSS and vibration induced anabolic response in osteocytes will be studied as follows. IDG-3SW osteocytes will be seeded at 4×10^5/well on $35 \times 78mm^2$ glass slides coated with type I collagen. The cells will be subjected to a laminar steady flow of $12dynes/cm^2$ with or without vibration ($20\mu m$ displacement, 4Hz) for 1 hour. After one hour of stimulation, the cells will be lysed for RNA and protein isolations. Real time PCR and western blot will be employed to study the mRNA expression and protein production of three metabolic bone markers - SOST, OPG and RANKL, respectively. One-way ANOVA will be performed to test the significance of the treatments at $p < 0.05$ level.

FORWARD THINKING/INNOVATION
To the best of our knowledge, we are the first to study the synergistic effect of vibration and FSS on the new osteocytes cell line – IDG-3SW. This project aims to uncover the synergistic effect of vibration and FSS and provide us an opportunity to optimize vibration to enhance the anabolic effect of bone in response to mechanical loading (FSS).

STUDENT INVOLVEMENT Matthew Bernard, a junior pre-dental student will fully participate in this project. He will completely be involved in designing and implementing experiments, analyzing data and writing research paper.

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PROJECT TITLE: "Automation of ARMA model for energy demand prediction"
FACULTY NAME: Richard J. Povinelli
STUDENT NAME: Sanzad Siddique

INTRODUCTION

Autoregressive Moving Average (ARMA) is a popular and an effective statistical model for time series analysis and prediction. The concept of ARMA was popularized by Box and Jenkins [1] in 1970. Since then, it has become one of the most used statistical methods for time series analysis and prediction. However, defining the complete model requires several manual steps, including finding the appropriate orders, determining coefficient values, error analysis, and corrections of the model parameters. By applying different techniques and algorithm, it should be possible to automate the process to find out the most suitable ARMA model that can predict the time series with minimum error. Our approach is to find out and combine those techniques to design and build an intelligent system which can automate the searching and defining best ARMA model that can represent (predict) the time series with minimum error. Our major focus is the time series data those are related with energy demand.

SIGNIFICANCE

Prediction of energy demand is an important factor in a sense that, it is possible to avoid unnecessary energy loss if the demand can be accurately estimated. The process of energy demand estimation involves statistical model identification and prediction using the identified model. Generally, the complete model identification process is complex and requires substantial manual effort. Our goal is to minimize this manual effort in building a model for estimation of energy demand. We should be able to come up with an automated intelligent system that can automatically perform all the necessary steps of building the statistical model.

FORWARD THINKING/INNOVATION

The automated process should be built on different phases. The model identification involves two main steps: order identification and parameter estimation. We are developing methods for finding the most appropriate model order. There are different techniques available [2-4], and we need choose the most suitable one by performing the necessary analysis and testing. Our long term goal is to extend our work on ARMA automation to other statistical models, which will lead us towards our ultimate goal, which is searching the best model within the space of all models.

STUDENT INVOLVEMENT

Sanzad Siddique is going to perform necessary literature search, development of the automated system using appropriate tools as guided by Dr. Povinelli. He should perform testing and will do the required modification. He should try with different methods for identifying the order, parameters then choose the best among those and combine them together.

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OUTLIER DETECTION TECHNIQUE FOR DATA CLEANING IN THE NATURAL GAS DOMAIN

Hermine Akouemo, Dr. Ronald H. Brown, and Dr. Richard Povinelli
Department of Electrical and Computer Engineering, Marquette University

INTRODUCTION

Low cost and reliable natural gas deliveries are important for both Local Distribution Companies (LDC) and their customers. In order to make an accurate forecast, having clean data or cleaning the data we have is an important step in the process of natural gas forecasting. Outlier detection which is a specific type of data cleaning is a very complex subject. Therefore, its analysis will be restrained to the natural gas demand context.

Purpose: The goal of the outlier detection technique is to help in the accuracy of the daily forecasting of natural gas demand.

METHOD

An accurate forecast of natural gas consumption is a very important tool for LDC's because it helps them make cost savings. These costs include penalties from ordering too much gas or for not ordering gas in advance. It also includes costs due to gas shortage which is the most critical event an LDC need to deal with. The main objective of the GasDay is to address those customers' issues by providing them an accurate as possible natural gas forecasting.

The outlier detection technique uses probabilities and the technique will be expanded later to time series data. A threshold is defined as a chosen single value and using the threshold, and a defined probability distribution function, the number of outlier in a particular data set can be found. The disadvantage of the technique using probabilities is that the data set needs to follow the distribution if not the number of outliers will be corrupted. The technique will be further developed using the Reconstructed Phase Space technique that can account for multiple particularities and features of the data.

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PROJECT TITLE: "A Computationally Efficient Technique for Regional Pole Placement"
FACULTY NAMES: Susan Schneider and Edwin Yaz, Electrical and Computer Engineering
STUDENT NAMES: Winston Baker and Fan Feng, Electrical and Computer Engineering

INTRODUCTION

The design of dynamic feedback controllers for linear continuous time systems is considered in this work. In dynamic feedback control, estimates of the state variables of the system are used in the control action. In order for this control scheme to be effective, the observer used to estimate the system state must be "fast acting", that is, estimates of the system state must approach the actual value of the state quickly which, in turn, means that the observer poles must be located well to the left of the controller poles in the complex plane. Easily applied pole placement numerical techniques for linear systems are readily available, such as MATLAB's *place* or *acker* commands.

SIGNIFICANCE

Our goal is to apply the concept of regional pole placement to design dynamic feedback controllers for non-linear systems. In regional pole placement, the separation of the observer and controller poles is achieved by locating the poles of the linearized portion of the system within well-defined regions of the complex plane, such as circles, ellipses, or vertical strips in contrast to previously mentioned methods which place the poles at exact locations. Regional pole placement for linear systems has been done using linear matrix equations, LMEs, [1, 2], or linear matrix inequalities, LMIs, [3]. The objective of this work is to design dynamic feedback controller based on regional pole placement using mixed LMI/LME techniques. Our preliminary research shows that a combination of LMI/LME techniques enables pole placement design for the linearized system's observer and controller and, because of the nature of the mixed LMI/LME formulation, certain robustness and resilience properties of the controller and observer are guaranteed [4]. These properties will allow for the design of dynamic controllers for certain classes of nonlinear systems using the mixed LMI/LME technique.

FORWARD THINKING / INNOVATION

At present, there appears to be no computationally efficient technique to accomplish combined LMI/LME design. Currently, only one software package (SCILAB) claims to perform mixed LMI/LME designs. However, in our preliminary testing, SCILAB has failed to produce accurate results. Therefore, it is necessary to identify and validate more efficient numerical scheme(s) to implement the mixed LMI/LME techniques.

STUDENT INVOLVEMENT

The graduate students will carry out the research on numerical methods that will accurately and efficiently solve the proposed mixed LMI/LME dynamic feedback controller design. They will validate the proposed technique via simulation of dynamic control design for several linear benchmark control systems (e.g., mass-spring-damper, inverted pendulum). Ultimately, we seek to use these numerical techniques for mixed LMI/LME regional pole placement dynamic feedback controller design for nonlinear systems with, for example, norm-bounded nonlinearities.

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PROJECT TITLE: "The effect of a single session of barefoot training on the kinematics and muscle activation in recreational runners"
FACULTY NAME: Andrew Starsky MPT, PhD, Clinical Assistant Professor, Physical Therapy
STUDENT NAMES: Albojay Deacon, SPT, Physical Therapy Student
Kristi Laurenzi, SPT, Physical Therapy Student

INTRODUCTION

"Natural Running" is a running style that is gaining in popularity. It involves running quietly, landing on the midfoot or balls of the feet, and stepping with a high cadence. Research is starting to show that this style of running may decrease the risk of certain types of injuries[1] and thus many runners that may seek medical attention for an injury are inquiring about learning this running style. Many running experts are teaching that everyone can learn the natural style by simply running for a few minutes while barefoot. Barefoot running essentially forces a runner to adopt the natural running style. It is unknown, however, if this style remains once a runner puts their shoes back on and attempts to continue the style on their own. We hypothesize that a single session of barefoot running is not enough to elicit lasting changes in an individual running style.

SIGNIFICANCE

Research has shown that when adopting the natural running style, the biggest change is found in the slope of the impact force, as measured by the ground reaction force[2] (GRF). Our pilot data has shown that recreational runners can reduce their impact force slope to 3.3 kN/sec after one session of barefoot running. This change is slope is not retained after two weeks, however, but is re-learned after another barefoot running session, and, in fact, decreases even further to 2.1kN/sec. We hypothesize that a single session of barefoot training, as promoted by experts in the field, will not be enough for a subject to learn and retain these changes.

FORWARD THINKING/INNOVATION

This project is innovative as it will use a state of the art 14 camera motion analysis system and 16 channels of EMG to examine joint motion and muscle activity in recreational runners after a single session of barefoot training.   The results of this study may yield some ideas for optimizing gait retraining in recreational runners, which are not present in the current literature. The research is simple enough for student involvement, yet very meaningful to a large clinician population.

STUDENT INVOLVEMENT

Mr. Deacon and Ms. Laurenzi will perform the testing of subjects in this study. Subjects will complete two running sessions within the motion analysis lab. Dr. Starsky will assist with the data analysis and dissemination.

REFERENCES

1. Lieberman, D., Venkadesan, M., Werbel, W. Foot strike patterns and collision forces in habitually barefoot versus shod runners. Nature 2010;28:531-535
2. Crowell, H., Davis, I. Gait retraining to reduce lower extremity loading in runners. Clinical Biomechanics 2011; 26:78-83.

Keywords