Congratulations!

Congratulations to the 2015 Doctoral Graduates for their many accomplishments and contributions. Thank you for choosing UCF for your graduate study!

Congratulations to the faculty members who guided these students through their academic and professional development. Thank you for your dedication and mentoring!

Dr. Mubarak Shah
Interim Vice Provost and Dean
UCF College of Graduate Studies
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This book includes doctoral graduates from 2015 who gave written permission to include their information.
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The doctoral graduates honored in this book are representative of the more than 4,000 doctoral alumni who chose UCF for their graduate study. During their time with us we delivered the academic rigor and collegiality of our exceptional graduate programs, as well as support, services and many opportunities, to help them achieve the best graduate experiences possible and complete their degrees.

We have greatly enjoyed our years with these scholars and are grateful for their many contributions to UCF. Doctoral students participate in research groups, assist with writing papers and applying for funding, represent UCF at conferences and publish their research. They also teach undergraduate courses and lab experiences, mentor master’s and undergraduate students, and enrich the academic and community experience of their fellow doctoral students through lively discussions. Through their many accomplishments, they bring recognition to UCF while they are here and also when they leave us.
Beliefs about the relationship between human beings and computing machines and their destinies have alternated from heroic counterparts to conspirators of automated genocide, from apocalyptic extinction events to evolutionary cyborg convergences. Many fear that people are losing key intellectual and social abilities as tasks are offloaded to the ‘everyware’ of the built environment, which is developing a mind of its own. If digital technologies have contributed to forming a dumbest generation and ushering in a robotic moment, we all have a stake in addressing this collective intelligence problem. While digital humanities continue to flourish and introduce new uses for computer technologies, the basic modes of philosophical inquiry remain in the grip of print media, and default philosophies of computing prevail, or experimental ones propagate false hopes. I cast this as-is situation as the post-postmodern network dividual cyborg, recognizing that the rational enlightenment of modernism and regressive subjectivity of postmodernism now operate in an empire of extended mind cybernetics combined with techno-capitalist networks forming societies of control.

Recent critical theorists identify a justificatory scheme foregrounding participation in projects, valorizing social network linkages over heroic individualism, and commending flexibility and adaptability through life long learning over stable career paths. It seems to reify one possible, contingent configuration of global capitalism as if it was the reflection of a deterministic evolution of commingled technogenesis and synaptogenesis. To counter this trend I offer a theoretical framework to focus on the phenomenology of software and code, joining social critiques with textuality and media studies, the former proposing that theory be done through practice, and the latter seeking to understand their schematism of perceptibility by taking into account engineering techniques like time axis manipulation. The social construction of technology makes additional theoretical contributions dispelling closed world, deterministic historical narratives and requiring voices be given to the engineers and technologists that best know their subject area. This theoretical slate has been recently deployed to
produce rich histories of computing, networking, and software, inform the nascent disciplines of software studies and code studies, as well as guide ethnographers of software development communities.

I call my syncretism of these approaches the procedural rhetoric of diachrony in synchrony, recognizing that multiple explanatory layers operating in their individual temporal and physical orders of magnitude simultaneously undergird post-postmodern network phenomena. Its touchstone is that the human-machine situation is best contemplated by doing, which as a methodology for digital humanities research I call critical programming. Philosophers of computing explore working code places by designing, coding, and executing complex software projects as an integral part of their intellectual activity, reflecting on how developing theoretical understanding necessitates iterative development of code as it does other texts, and how resolving coding dilemmas may clarify or modify provisional theories as our minds struggle to intuit the alien temporalities of machine processes.

Committee: Bruce Janz (Chair), Anthony Grajeda, Rudy McDaniel, and Charles Hughes

*Graduated Fall 2015*
Good Works: The Topoi of Corporate Social Responsibility in the Travel and Tourism Industry

CONNIE CULLER
Texts and Technology PhD

This dissertation focuses on the identification and analysis of Corporate Social Responsibility (CSR) topoi in the travel and tourism industry. A sample set of six companies was selected for the study due to their size and prominence in the industry — namely Disney, Hilton, Intercontinental, Marriott, Starwood, and Wyndham. Topoi were identified through a blended method of research that employed rhetorical analysis, modified grounded theory, and NVIVO content analysis software. The research followed three guiding principles to recognize textual cues and drive analysis: common and special topoi; topoi as heuristic; topoi for association and amplification; and topoi as fluid and movable. The common CSR topoi, triple bottom line and shared value, were also used as overarching categories for coding the texts. The results of the method yielded six unique topoi that were specific to each company; these included Inspiration, Higher Purpose, Collaborative Innovation, Leadership, The Age of Great Change, and Green. Results also included a set of seven special industry topoi that were common across all of the sample companies; these included Commitment, Management, Alignment, Environment, Engagement, Achievement, and Sustainability. The rhetorical synergy and topological levels identified through this research can inform other studies of CSR about the generative potential of topoi and its fluidity when viewed from different conceptual vantage points.

Committee: John Scott (Chair), Dan Jones, Angela Rounsaville, and Rebecca Dingo

Graduated Fall 2015
The Practice and Benefit of Applying Digital Markup in Preserving Texts and Creating Digital Editions: A Poetical Analysis of a Blank-Verse Translation of Virgil’s *Aeneid*

WILLIAM DORNER
*Texts and Technology PhD*

Numerous examples of the “digital scholarly edition” exist online, and the genre is thriving in terms of interdisciplinary interest as well as support granted by funding agencies. Some editions are dedicated to the collection and representation of the life’s work of a single author, others to mass digitization and preservation of centuries’ worth of texts. Very few of these examples, however, approach the task of in-text interpretation through visualization.

This project describes an approach to digital representation and investigates its potential benefit to scholars of various disciplines. It presents both a digital edition as well as a framework of justification surrounding said edition. In addition to composing this document as an XML file, I have digitized a 1794 English translation of Virgil’s *Aeneid* and used a customized digital markup schema based on the guidelines set forth by the Text Encoding Initiative to indicate a set of poetic figures—such as simile and alliteration—within that text for analysis. While neither a translation project nor strictly a poetical analysis, this project and its unique approach to interpretive representation could prove of interest to scholars in several disciplines, including classics, digital scholarship, information management, and literary theory. The practice serves both as a case-in-point as well as an example method to replicate with future texts and projects.

Committee: Mark Kamrath (Chair), Rudy McDaniel, John Applen, and Sydney Bauman

*Graduated Spring 2015*

EMILY JOHNSON

Texts and Technology PhD

This dissertation investigates the question, “How can the procedural rhetoric of three whole-body educational games improve the understanding of self-regulated learning with digital technology?” It explores three whole-body educational games (WBEGs) using a quantitative study, a case study, and analyses of their procedural rhetoric to better understand the roles these types of games can have in teaching digital literacy and self-regulated learning (SRL) skills. The three WBEGs, Waves, Color Mixer, and Light and Mirrors, are each intended to teach science concepts to players. These games are similarly structured in that they all invite players to immerse themselves in the game by standing on the “screen” (the games project images on the floor). The WBEGs differ from traditional console video games because they receive input from players via motion-sensing technology, requiring players to make large movements with their bodies to influence elements within the game. This study explains SRL as a complex combination of internal (mental) behavior, external (observable) behavior, and interpersonal (social) behavior, identifying within three WBEGs the presence of elements supporting the SRL behaviors of goal setting, strategy planning, collaboration, progress monitoring, feedback, and reflection. These findings inform the understanding of SRL by revealing that each game includes a different combination of SRL-supporting elements that encourage the use of SRL skills in different ways. SRL scaffolding features are those elements within a WBEG that guide players to use certain SRL strategies, helping and supporting their efforts much like construction scaffolding supports a building as it is being erected. This dissertation also utilizes analyses of procedural rhetoric to investigate the techniques reinforced by the underlying structure of these three WBEGs in an effort to further the understanding of digital literacy in education and sociocultural contexts. All three WBEGs appear to emphasize player agency and collaboration. Waves and Light and Mirrors encourage player strategy, while Color Mixer rewards speed and rote knowledge. These reinforced techniques perpetuate the underlying cultural values of accuracy, collaboration, problem-solving,
autonomy, and scaffolding. This study discusses these values in the contexts of education and society.

Committee: Thomas McDaniel (Chair), Stephanie Vie, John Applen, Stacey Pigg, and Robb Lindgren

Graduated Fall 2015
The Impact of User-Generated Interfaces on the Participation of Users with a Disability in Virtual Environments: Blizzard Entertainment’s World of Warcraft Model

DONALD MERRITT
Texts and Technology PhD

When discussing games and the experience of gamers those with disabilities are often overlooked. This has left a gap in our understanding of the experience of players with disabilities in virtual game worlds. However, there are examples of players with disabilities being very successful in the virtual world video game World of Warcraft, suggesting that there is an opportunity to study the game for usability insight in creating other virtual world environments. This study surveyed World of Warcraft players with disabilities online for insight into how they used interface addons to manage their experience and identity performance in the game. A rubric was also created to study a selection of addons for evidence of the principles of Universal Design for Learning (UDL). The study found that World of Warcraft players with disabilities do not use addons more than able-bodied players, but some of the most popular addons do exhibit many or most of the principles of UDL. UDL principles appear to have emerged organically from addon iterations over time. The study concludes by suggesting that the same approach to user-generated content for the game interface taken by the creators of World of Warcraft, as well as high user investment in the environment, can lead to more accessible virtual world learning environments in the future.

Committee: Thomas McDaniel (Chair), Pavel Zemliansky, Barry Mauer, and Si Jung Kim

Graduated Spring 2015
This project examines the relationship between gendered identities, virtual communities, and material bodies, with an emphasis on eating disorders and self-injury practices. The use of the internet to represent and foster particular categories of material bodies, such as the anorexic, the fitness buff, and the self-injurer, has gained substantial visibility due in part to the proliferation of visual imagery presented through social networks. I analyze written and visual texts within specific social networks to assess their function and potential impact on individuals and larger communities.

Drawing from Donna Haraway’s cyborg theory, N. Kathryn Hayles’ posthuman, Judith Butler’s performativity, feminist poststructural analysis, and the notion of augmented reality, this project explores how individuals rely on social networks, images, and technologies to provide supportive environments for, as well as modify and maintain, specific gendered bodies. Applying feminist interpretations of Foucault’s concepts of discipline and “docile bodies,” primarily the research and critiques of Susan Bordo, Anne Balsamo, and Armando Favazza (among others), I examine how image sharing and interactions via social networks and communities affect material bodies and function as forms of social control, normalizing and encouraging ultra-thin bodies and dangerous behaviors, including eating disorders, overexercise, and cutting.

I also explore subversive strategies of resistance enacted both within and beyond pro-ana and self-injury communities to counter negative messages and promote positive body image in girls and women.

Committee: Melody Bowdon (Chair), Blake Scott, Martha Brenckle, and Maren Fragala

Graduated Spring 2015
College of
BUSINESS
ADMINISTRATION
Three Studies Examining the Effects of Psychological Distance on Judgment and Decision Making in Accounting

MARTIN WEISNER

Business Administration PhD - Accounting

This dissertation comprises three studies, a literature review and two experimental studies, that center on the effects of psychological distance on judgment and decision-making in accounting. Construal level theory (CLT) of psychological distance (Liberman and Trope 1998; Trope and Liberman 2003), a framework recently developed in the field of social psychology, constitutes the theoretical foundation for each study.

The first study reviews extant literature on CLT and illustrates the theory’s potential for investigating previously unexplained phenomena within the accounting domain. Selected publications that apply CLT in contexts that are of particular interest to accounting researchers are emphasized and a series of broad, CLT-based research questions pertaining to various accounting domains are offered. The second study applies CLT to the audit context by investigating whether the performance of common auditing tasks that require varying degrees of abstract thinking affect decision-makers’ overall mindset and hence their subsequent judgment. Results from the second study have important implications for audit practice as auditors work in environments that require frequent shifts in focus due to multiple client or project demands. The third study applies CLT to the enterprise risk management context by examining how spatial distance from a risk assessment object and risk category (i.e., the type of risk) affects decision-makers’ assessment of the probability that the risk will materialize. The third study thus informs the corporate governance literature by identifying psychological distance as a potential source for judgment bias during the risk assessment process.

Overall, the results reported in this dissertation suggest that psychological distance systematically affects individuals’ judgment subject to the caveat that the judgment of concern falls within the domain of the decision-maker’s routine cognition. By presenting empirical evidence from both the audit and the risk management domain, the studies contribute to our understanding of
the heuristics and biases in judgment and decision-making in professional settings that are of interest to accounting research.

Committee: Steven Sutton (Chair), Vicky Arnold, Sean Robb, and William Messier

Graduated Spring 2015
Judged by the Bottom-line But Expected to Lead Ethically: A Leader’s Catch 22

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**DARRYL RICE**  
*Business Administration PhD - Management*

The goal of the presented research is to explain the importance of integrating the literatures on leader bottom-line mentality (BLM) and behavioral ethics and to demonstrate that leader BLM can adversely impact followers’ perceptions of ethical leadership. By doing so, several contributions can be made. First, I identify an antecedent of ethical leadership. Predominantly, most ethical leadership research has focused on identifying its outcomes (Brown & Mitchell, 2010). Second, I will offer new theoretical insights regarding the antecedents of ethical leadership. Past ethical leadership research has primarily relied on social exchange (Blau, 1964; Gouldner, 1960) and social cognitive (Bandura, 1977, 1986) theories, whereas I will draw on trait activation and cognitive stress theories to examine the relationship between BLM and ethical leadership. By integrating these two theories I will demonstrate Kerr’s (1975) example of “the folly of rewarding A, while hoping for B.” Third, I will explain and demonstrate why follower BLM and leader stress perceptions are important boundary conditions regarding the primary relationship of interest and overall model. Comprehensively, I examine and demonstrate the potential of a backfiring effect that can be strengthened or weakened. This research aims to shed light on the often disregarded catch-22 leaders face in a world that is increasingly concerned about bottom-line outcomes, while also demanding an immaculate standard of ethical behavior from leaders.

Committee: Robert Folger (Chair), Shannon Taylor, Craig Crossley, and Ronald Piccolo

*Graduated Spring 2015*
Compassion in Organizations

REGINA TAYLOR
Business Administration PhD - Management

Research on compassion in organizations has grown over the last decade, however, there is still a need for empirical work on the topic before we truly understand compassion and the various factors that influence it in everyday organizational life (Atkins & Parker, 2012; Dutton, Workman & Hardin, 2014). The purpose of this dissertation is to review the current literature on compassion in organizations and extend research on compassion by exploring potential moderators of the relationship between compassionate feelings and compassionate responses from potential compassion givers. The moderators under investigation are in the form of individual (i.e., moral identity, moral disengagement), situational (i.e., cognitive appraisals) and organizational (i.e., ethical leadership, ethical climate) contextual variables. Findings from experimental and field studies are presented. Theoretical and practical implications of compassion in organizations are discussed, and areas for future research are identified.

Committee: Marshall Schminke (Chair), Robert Folger, Maureen Ambrose, and Stephen Sivo

Graduated Spring 2015
Essays on Sales Force Career Incentives

SOMNATH BANERJEE
Business Administration PhD - Marketing

This dissertation uses game theoretic models in a principal-agent framework to study how firms optimally manage long term career related incentives for their sales people. When sales people put sales effort they face incentives not only from short term incentives like commissions and bonuses but also from long term rewards associated with progression in their career. In particular, sales people are often motivated to get promoted and avoid being laid off, to get selected to managerial positions and to form stronger relationships with customers so that they can bargain for higher wages in the future, respectively. Three different essays examine each of these three career related incentives and how firms can optimally manage them.

Essay 1 (Chapter 2) studies why and how firms use a type of promotion and layoff policy, called the Forced Ranking policy, to provide optimal long term career incentives to sales people. Findings from the essay suggests that when sales people are ambiguity averse and there is economic uncertainty regarding promotions and layoffs, firms are likely to commit to a promotion policy but may or may not commit to a layoff policy as part of Forced Ranking. Interestingly, it is shown that firms enjoying higher margins are more likely to commit to both promotion and layoffs, consistent with observations from industry practice. Results also suggest that in absence of costs from promoting and laying off employees, firms should use an up-or-out contract to motivate the sales force.

Essay 2 (Chapter 3) investigates how career incentives associated with promotion of sales employees to sales management roles may interfere with selection of the right sales managers. The essay was motivated by the common observation that organizations often promote their best sales people to sales managerial roles but after promotion find that the sales people are not as good as they were expected to be in their new roles, a phenomenon called Peter Principle. An alternative explanation for this phenomenon of adverse selection is provided and possible solutions are analyzed as part of the essay.
In essay 3 (Chapter 4) long term career incentives that sales reps face when they can form relationships with their customers are considered. Loyalty generated from customer-salesperson relationships is often “owned” by the sales person and it can be lost if the sales person moves to another firm. Therefore, firms compete for both customers as well as sales reps with the objective of poaching customers that are loyal to the sales reps. The essay analyzes how firms can deal with such a competition. Findings suggest that contrary to general beliefs, the presence of anti-employee poaching regulations like Non-Compete clauses, or tacit collusion to not poach each other’s employees may hurt firm profits under some conditions.

Overall, the dissertation answers how firms can manage sales force career incentives to maximize profits.

Committee: Axel Stock (Chair), Anand Krishnamoorthy, Amit Joshi, and Wilfred Amaldoss

Graduated Summer 2015
Peering into the Future: Three Essays on the Nascent Phenomenon of Collaborative Consumption

REBECA DELLEGRAZIE-PERRREN
Business Administration PhD - Marketing

The primary objective of this dissertation is to examine the theoretical and practical implications of the collaborative consumption phenomenon for individuals, businesses and society. To accomplish this goal, a research approach at three levels of analysis is used to explore how market institutions and consumer practices negotiate a social order that combines the social domain of peers with the economic domain of market exchange. The first essay of the dissertation approaches this objective from a macro level to examine how social order is produced and sustained through the systemic interactions of service firms and peers. This essay provides a framework to understand the emergent business models by developing a typological theory that explains how platforms can be configured for higher value creation. The second essay approaches our understanding of the phenomenon from a meso level analysis to examine how peers interact with the social order of collaborative consumption markets to negotiate key existential tensions between consumer resistance and market appropriation. This essay explores the metaphors that peers use to construe the field of collaborative consumption. Through the interpretive analysis of participant-generated images, this research uncovers the prevailing use of a liberation metaphor that reveals a new way of thinking about resource circulation. Lastly, the third essay employs a micro level of analysis to examine how participation in collaborative consumption practices provokes intrapersonal dynamics leading to moral decay. By relying on a social cognitive framework that considers how behaviors impact personal and environmental factors in a recursive fashion, this essay scrutinizes when and how prolonged participation can erode moral identity and negatively impact prosocial behaviors. Together, this holistic approach advances our theoretical understanding of the collaborative consumption phenomenon and provides practical implications for managerial practice and public policy.

Committee: Carolyn Massiah (Chair), Xin He (Co-Chair), Ata Tafaghodijami, and Liz Grauerholz

Graduated Summer 2015
Essays on Marketing Strategies in the Context of Interdependent Consumption

MINOO TALEBI ASHOORI

Business Administration PhD - Marketing

This dissertation consists of two essays in which I study the impact of two interdependent consumer behaviors, fairness concerns and exclusivity seeking, on a company's marketing strategies and profits specifically in a context where it tries to expand its clientele with the objective of generating repeat purchases, for example by running deals on daily deal platforms. In the first essay, I examine the impact of customers fairness concerns on the profitability of a company running promotions on daily deal platforms. With the prevalence of social media and the internet, information about such targeted promotions can become available to all consumers including those who did not have access to the platform and paid a full-price. Conducting a laboratory experiment, I demonstrate that knowledge about targeted promotions often leads to post-promotional fairness concerns among these consumers resulting in an increased tendency to switch providers. Incorporating the results of the experiment in a two-period game-theoretic model I analyze the impact of customers post-promotional fairness concerns on the profits of quality differentiated companies who compete by running targeted promotions. I find that the low quality provider always suffers from consumers sensitivity to unfairness. Contrary, I show that the high quality provider can counterintuitively benefit from consumers fairness concerns as long as its quality advantage is not too large. Furthermore, I analyze how profits are impacted when information about the targeted deals leaks to non-targeted customers who would have bought at the regular price. I find that, counterintuitively, competing firms profits increase with leakage. In the second essay of this dissertation, I start with the observation that many platform members are new customers and are uncertain about the quality of the company's product or service until they consume it. In such a context, I examine a high quality seller's optimal signaling strategy in a market where consumers prefer to purchase a scarce product due to desire for exclusivity or to receive a service in a non-crowded environment due to better experience and service delivery. Utilizing a repeat purchase signaling model I show that, consistent with prior literature, the high quality firm signals its quality by making its product scarce as well as charging a high price when consumers desire for exclusivity is high and cost of quality is great. Contrary, I also find conditions under which the high quality firm counterintuitively makes its
product widely available and prices it low to signal its quality. The model may in part explain how high quality sellers market their products or services on daily deal websites.

Committee: Axel Stock (Chair), Lin Liu, Huifang Mao, and Michael Caputo

Graduated Summer 2015
College of EDUCATION AND HUMAN PERFORMANCE
Students Who Are Gifted and Public School Enrollment Choices Their Parents Make

LEIGH AUSTIN
Education EdD

Given the many school choices available to parents, there is a need to understand the reasons parents of a child who is gifted choose to keep their child in his/her current school. Parents’ satisfaction with their child’s school and their academic growth is essential to continued enrollment of the child in that school (Abdulkadiroglu, Angrist, & Pathak, 2011; Van Tassel-Baska, 2006). The parents’ decision to keep their child who is gifted enrolled in their current school may be influenced by factors within the school as well as those factors outside of the school. The purpose of this study was to research factors that may influence the parents’ decision to keep their child who is gifted enrolled in their current school. The research studied parental perceptions of academic support, social and emotional support, and principal support for gifted education for their child who is gifted and the parents’ willingness to keep their child who is gifted enrolled at their current school.

The target group in the study was parents of children who are gifted and enrolled in a very large urban school district but did not include parents of children who are gifted and also have a disability.

The research included the analysis of a survey and follow-up interview questions with parents of a child who is gifted and enrolled in the very large urban school district. There were 683 survey responses out of 4,401 total parents surveyed with a return rate of 16%. The low return rate is considered a limitation of the study and it is recommended to conduct additional research on the majority of parents who did not participate in the survey. Follow-up interviews were conducted with 10 randomly selected parents of children who are gifted and enrolled in the very large urban school district. The survey and interview data was coded and analyzed using IBM SPSS Statistics.

There were two research questions that guided the development of the research process and the analysis of data. The first question focused on indicators of parent satisfaction that included academic needs met, social and emotional needs met, and principal support for gifted education. The survey and interview data yielded mixed results with parents split between the
belief that their child’s academic needs were met, social and emotional needs were met, and that their child’s principal was supportive of gifted education. The second research question considered the relationship between the three indicators of parent satisfaction and the parents’ willingness to consider enrolling their child in a school solely for students who are gifted. The results showed that there is a statistically significant relationship between the parents’ belief that their child’s academic needs were met and the parents’ consideration to send their child to a school solely for students who are gifted. However, there was a lack of evidence to establish a relationship between parent’s belief about their child’s social and emotional needs or the parents belief that their child’s principal was supportive of gifted education.

The implications of the study are numerous. There are enough parents willing to consider sending their child to a school solely for students who are gifted to support opening the school. The majority of the survey participants had elementary school children; therefore, consideration should be focused on opening an elementary school for students who are gifted. Long range planning is needed to determine how to support the school for students who are gifted as well as the impact of transferring the students from one school zone to the school for students who are gifted. The literature reflected the diverse nature of the parents’ satisfaction with academic support, social and emotional support, and principal support for gifted education and revealed that when the parents’ are satisfied it does not guarantee that the parent will keep their child enrolled in their current school. The need for on-going communication between the school and the parents are critical to keeping the student enrolled in their current school.

Further research is needed to determine the beliefs of parents with children who are gifted and identify themselves as Black, Hispanic, Asian, or another race since the majority of the survey participants were White. More research is also needed to determine the reasons why large numbers of parents would consider sending their child to a school solely for students who are gifted regardless of their satisfaction levels with school support. In addition, further research needs to be conducted to determine why parents would choose to keep their child enrolled in their current school when the parents believed
their academic or social and emotional needs were not met or their principal was not supportive of gifted education.

Committee: Suzanne Martin (Chair), Mary Little, Gordon Baldwin, and Bridget Brooks

Graduated Summer 2015
Academic libraries are increasingly re-envisioning their services to provide expanded outreach and segmented programming for specific user groups. Many academic libraries offer segmented services and programming for undergraduate groups such as first-year experience programs and general education programs. Currently, academic libraries are also identifying and expanding their services and programming to meet the unique needs of graduate groups. In conjunction with this focus, the roles of academic librarians are also expanding in the area of outreach. In essence, academic librarians are becoming more directly involved in aligning library services and programming with academic programs and promoting change within their institutions. Faced with the challenges of outreach and promoting change it is essential that librarians gain deeper insights about the perspectives and needs of graduate programs and graduate groups to effectively plan and align library services.

The purpose of this design research study was to explore the organizational factors that influence how library services and library instruction are utilized in two doctoral programs in education at the University of Central Florida (UCF). Using a sequential mixed methods approach, quantitative data was collected in an online survey and qualitative data was collected in audio recorded interviews conducted with students enrolled in two doctoral programs in education, as well as program faculty, and academic librarians. Findings from this study were then used to describe a conjecture for an asynchronous online learning resource that applies elements outlined in Sandoval’s (2014) conjecture map model. Findings were also used to make recommendations about future planning for library outreach and the utilization of library services in the doctoral programs.

Committee: Glenda Gunter (Chair), David Boote, Thomas Vitale, and Edward Robinson

Graduated Spring 2015
Understanding the Beliefs and Attitudes of Mid-career Secondary School Teachers toward Teacher Evaluation and Its Effect on Their Professional Practice: A Mixed Method Phenomenological Study

WILLIAM BOOTH
Education EdD

The purpose of this mixed-method phenomenological study is to understand the beliefs and attitudes that mid-career secondary school teachers have regarding the teacher evaluation process and its effect on their professional practice. Mid-career secondary school teachers (defined as having between 14-21 years of classroom experience) from Bayview Public Schools were selected to participate. A total of 152 mid-career secondary school teachers completed an electronic survey. Additionally, a total of 9 participants took part in one-on-one semi-structured interviews.

The theoretical framework used to guide the study was the theory of planned behavior (TPB) (Ajzen, 1988; 1991) and Bandura’s theory of self-efficacy (1977). The quantitative results from the electronic survey were used to augment qualitative data collected from interviews with willing participants.

The interviews with study participants were analyzed for emerging themes. In all, a total of nine emerging themes came to light through the analysis of interview data. The data revealed areas of concern regarding the current method of evaluating teachers in Bayview Public Schools. A presentation of the findings with regard to the theoretical framework, literature, and practice were presented. Furthermore, a list of recommendations was provided addressing the specific concerns of participating teachers. In conclusion, recommendations were also made concerning future research that might continue to add to the body of knowledge concerning teacher evaluation.

Committee: Michele Gill (Chair), Rosemarye Taylor, Cynthia Hutchinson, and Mark Mullins

Graduated Summer 2015
Math Remediation for High School Freshmen

KAMBIZ BORHON
Education EdD

This study is an attempt to address the problem associated with a high percentage of freshman students, at a private Christian high school in Florida, who either fail Algebra 1 or pass with a low percentage rate. As a result, these students either retake Algebra 1 or continue on—being inadequately prepared to successfully pass Geometry and Algebra 2. This study concentrates on the student background knowledge of mathematics, which is among the causes associated with this problem, and proposes remediation. As such, a mathematics remediation course is designed and implemented for a select number of incoming freshmen. This study includes a correlational examination to determine a possible correlation between students’ background knowledge of the middle school mathematics and predicts a possible failure or successful completion of Algebra I in high school. In addition, it purposes a two-stage evolution plan in order to determine the effectiveness of the design of the remedial course as well as its effectiveness. Undertaking the design evaluation, this study uses a mixed-modes design consisting of a qualitative (interview and observation) of a number of participants and a quantitative examination (survey) of a larger sample. The correlational study indicates that there is a positive and moderately strong correlation between students’ background knowledge in (middle school) mathematics and their grades in Algebra 1. The evaluation concludes that students find the design of the MIP program helpful and aesthetically appealing; however, its usability did not meet the evaluation criteria. Furthermore, the MIP Program Manager and teacher are fully satisfied with its design, content, and components.

Committee: David Boote (Chair), Mike Hynes, Glenda Gunter, and Margaret Miller

Graduated Spring 2015
A Design and Implementation Plan for Professional Development and Curriculum Modules of Historical Literacy in the Social Studies Classroom

DANIEL COWGILL

Education EdD

The goal of this dissertation in practice was to create professional development and curriculum modules focused on historical literacy in order to help teachers fully engage students in learning historical literacy skills. Historical literacy is the ability to understand the importance of the source of a document, being able to close read a text, to place a source within its proper context, and to corroborate the information from one source to another. The implementation of a program of this nature is designed to help teachers and students develop these skills with the hope that it positively impacts not only student learning in the social studies classroom, but will also have a positive impact on student test scores, student college experiences, students’ future careers, and students’ role within our civic society.

Included within this dissertation in practice is a model for how to facilitate an effective professional development program that helps increase teacher efficacy, teacher skill level, and teacher use of historical literacy. This model pays special attention to ensuring that teachers also see how the demands of various standards and teacher evaluation systems can be addressed through the use of historical literacy.

Suggested use for this dissertation in practice is the creation of professional development programs that help schools implement best practices throughout the learning organization.

Committee: Carolyn Hopp (Chair), Thomas Vitale, Terri Fine, and Cicely Scheiner

Graduated Summer 2015
Principals’ Perceptions on Educating Elementary Students Who Are Gifted

INGRID CUMMING
Education EdD

Students who are gifted need student centered academic challenges and authentic problems to spark reflection and enhance student outcomes. When academic needs are not met, students who are gifted may not reach their full academic potential and may lose motivation for learning. A primary reason for students who are gifted to underachieve in academics is equated to school factors including lack of instructional resources, social/emotional support, and teachers who are unprepared to teach students who are gifted. The purpose of this phenomenological research study is to explore the perceptions and lived experiences of participating elementary school principals in an urban school district. The research questions explore elementary school principals’ perceptions of the implementation of practices, programs and instructional methods that support their programs for students who are gifted and the teachers of students who are gifted.

Committee: Suzanne Martin (Chair), Mary Little, Vassiliki Zygouris-Coe, and Amanda Ellis

Graduated Fall 2015
Examining the Perspectives of Students with Learning Disabilities through Their Lived Experiences

HANNAH EHRLI
Education EdD

The purpose of this study was to examine the perspectives of college students with learning disabilities through their lived experiences. Specifically, as they related to their high school learning experiences, their transition to higher education, and their continued academic and social support in higher education. The researcher gathered qualitative data to gain insight into the world of students with learning disabilities. The study consisted of a survey, focus group, and in-depth interviews. The data were reviewed in order to achieve a holistic picture of what the students’ perceptions illustrate and to understand thematic commonalities from their lived experiences. The researcher hoped to shape possible effective instructional strategies and supports for students with learning disabilities in secondary and post-secondary educational experiences.

Committee: Suzanne Martin (Chair), Martha Lue, Matthew Marino, and Anna Diaz

Graduated Summer 2015
Build Your Own Adventure ACT Prep Manual: 
Beating the Odds of High-Stakes Standardized 
Assessments

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NATALIE HOLTER

Education EdD

Today’s focus on high-stakes standardized tests has had a massive impact on education throughout America, and standardized test preparation is one of the ugly, open secrets of education. Ever since 2001 when President Bush signed into law No Child Left Behind (NCLB), a bipartisan reauthorization of Johnson’s landmark Elementary and Secondary Education Act of 1965, students have been bombarded with standardized tests from the earliest grades. Politicians believe these measures are the only way to remedy the perceived weaknesses in the education system because “stringent accountability mandates… [provide] vital levers of change, inclusiveness, and transparency of results” (Education Week, 2011, para. 15). Yet as time progresses, the quantity and importance of the exams increase to such proportions that, by the time students are in high school, their performance dictates whether they will graduate or attend college. While proponents of such exams say that they only test the skills that students ought to be learning anyway, the reality tends to be that teachers start to focus only on the specific questions the test will cover, and thereby lose the ability to provide full, comprehensive education. “Teaching to the test” is the much-maligned experience of most high schools. In order to combat the pressure students feel to perform and teachers feel to shortchange the learning experience, a “Build Your Own Adventure” manual designed around research-based principles demonstrated to improve student learning gains will allow students to focus on the key areas needed to improve test performance, demystify the test itself, and thus help students obtain score improvement. In so doing, students will not only perform better on standardized assessments, but ultimately be able to attend more elite colleges.

Committee: David Boote (Chair), Grant Hayes, Rosemarye Taylor, and Thomas Vitale

Graduated Summer 2015
Applying Problem-of-Practice Methods from the Discipline of Higher Education within the Justice System: Turning the Concept of Therapy Dogs for Child Victims into a Statewide Initiative

JESSIE HOLTON
Education EdD

This Dissertation-in-Practice introduces a law enforcement concept-to-practice model designed by combining tested methods of organizational analysis often utilized by those in the discipline of education. The model incorporates a two phase design with the first phase focusing on implementing and evaluating innovative changes within a medium size law enforcement agency for a micro-level analysis. A second phase examines the ability to replicate the concept program on a statewide, macro-level, by incorporating a re-design method utilizing organizational resource and structure frames. The concept applied to this model was the introduction of a therapy dog interaction during investigations involving crimes against children to reduce anxiety and increase communication. The first phase concluded that the introduction of therapy dogs during law enforcement investigations had a statistical significance in the reduction of anxiety and increased disclosure rates with child victims, without interfering with judicial policies and procedures. The second phase produced a series of flexible options allowing law enforcement agencies of all types to replicate therapy dog programs that are consistent, cost effective, and sustainable. The overall results indicate the use of this concept-to-practice model was successful in examining and introducing an innovative concept that provided a significant impact in the complex organizations of the justice system.

Committee: Carolyn Hopp (Chair), Thomas Vitale, Karri Williams-Fjeldhe, and Elizabeth Mustaine

Graduated Summer 2015
A Formative Evaluation of a Technology-mediated Alternative to Traditional Study Abroad

WENDY HOWARD
Education EdD

Purpose: The purpose of this study was to determine if a proposed technology-mediated intervention is a viable alternative to traditional study abroad for those who are unable to travel. While technology cannot reproduce the same experience of traveling abroad, the primary objective of this study was to determine if there is value in using Web conferencing technology to provide students with access to the same opportunity to interact with international experts in the field as their counterparts who were able to travel. This formative evaluation is the first in a series of iterative studies aimed at developing a viable, sustainable, technology-based solution through design-based research (Reeves, 2006).

Methodology/Design: Two guiding questions drove the focus of this formative evaluation: Did the program accomplish what was intended and was it implemented effectively? These generated a set of evaluation questions using the Online Learning Consortium (OLC) Quality Framework, which were used to evaluate the quality of a joint study abroad program in Brazil with students and instructors from the University of Central Florida and the University of Scranton. While studying global health management in Brazil, the group in the field broadcasted their site visits live to online participants back in the United States. Web conferencing tools allowed the online attendees to see and hear the group in Brazil and interact in real time through the audio or text chat. Evaluation data was compiled from multiple sources including an anonymous student survey, instructor interviews, session recordings, financial budgets, and online facilitator observations in order to triangulate and evaluate the effectiveness of this Web-based intervention.

Findings: Web conferencing technology appears to be a viable alternative that is not necessarily as immersive as traveling abroad, but it does provide its own set of benefits to higher education students. This formative evaluation revealed clear areas for improvement, including technical and procedural elements, but instructors and online participants did find value in the experience. Was it perfect? No. Was it successful? Yes. Was it
encouraging? Definitely. Exploration of the evaluation questions under each of the five pillars of the OLC Quality Framework revealed both success factors and areas for improvement in each of the following categories: learning effectiveness, scale (commitment & cost), access, faculty satisfaction, and student satisfaction.

**Implications:** Overall, this was a successful proof of concept that justifies future improvements and subsequent further evaluation in an iterative design-based research program. In addition to repeating this study with the joint global health management course in Brazil, this intervention could also be implemented and evaluated in other contexts, disciplines, and countries around the world. This formative evaluation produced a set of recommendations for the next study based on the success factors as well as the areas for improvement identified in this initial implementation in addition to a list of suggestions for future research.

Committee: Glenda Gunter (Chair), Bernardo Ramirez, Thomas Vitale, and Patsy Moskal

*Graduated Summer 2015*
Systems Design: Academic Advising System Implementation, A Case Study of User Centered System Design at the University of Central Florida

TRACY JONES
Education EdD

This dissertation presents a case study in user-centered design completed at the University of Central Florida. Leadership in the College of Graduate Studies at UCF realized the need for an advisement tool to assist advisors in the academic colleges to track the success of their students.

After an advisement product was selected, the user-centered design approach started to be implemented. End-users were shown the basic functionality and known benefits of the product. Then they were asked how they could make it standardized across programs. The users selected the order in which information and degree requirements should display. The users asked for additional information to be shown on the new advising report called the Graduate Plan of Study (GPS). This information would assist them in advising students and certifying that the students’ had met requirements to earn their degree.

With the help of the end-users, a prototype was developed and delivered to computer services. End users assisted with the testing of current and additional functionality. After attending focus groups, the end-users had a better understanding of the need for testing. They assisted in providing ideas for training and a deployment plan to the university. The use of the user-centered design approach helped to keep our end-users engaged in the project. They were the central cause of the successful implementation of a new advisement module for graduate students at UCF.

Committee: David Boote (Chair), Grant Hayes, Mary Little, and Thomas Vitale

Graduated Spring 2015
Exploring Leadership Experiences of School Psychologists in Supporting Schools: A Phenomenological Study

JULIE JOSEPH
Education EdD

The passage of the No Child Left Behind Act (NCLB) and the reauthorization of the Individuals with Disabilities Education Act in 2004 have placed increased demands on all educators and administrators. School psychologists find themselves charged with addressing a broad range of issues today, and there is an emphasis on leadership in the effective provision of services. Although the literature is replete with examples of the centrality of leadership in regards to the educational experience of students, there have not been sufficient studies that have studied this topic in school psychology.

The purpose of this study was to discover, understand, and describe in rich detail the lived experience of school psychologists exercising leadership. The researcher interviewed school psychologists within a mid-size school district in Central Florida who were nominated by district administrators that supervise of them. Additionally, this study sought to identify the contexts, domains of practice, universal structures, and opportunities utilized in their experiences. School psychologists demonstrated leadership through collaboration and consultation, professional expertise, student-oriented needs, expert-problem solvers, and communication skills. The contexts of their leadership experiences varied due to the diverse roles taken on by the individual, however they were all demonstrated at the district level, school level, and with their peers.

The leadership experiences identified by the study participants correspond to most of the National Association of School Psychologists (NASP) domains of practice and also correspond to transformational leadership. The results are particularly salient to school psychologist, as the information comes from the perspective of school psychologists who were noted to be “effective” and displays “leadership” and are now exercising leadership. Future research is
encourage to examine leadership experiences across multiple school districts to identify experiences of other leaders across various settings.

Committee: Suzanne Martin (Chair), Mary Little, David Boote, and Arlene Thomson

Graduated Summer 2015
Organizational Factors That Influence the Retention of Special Education Teachers in Osceola County

CARLA KEENUM
Education EdD

The loss of special education teachers is a problem for all school districts. The effects of special education teacher attrition are felt in the classrooms and by all school district personnel. The impact on student achievement can be profound, especially if the teacher leaves in the middle of a school year. This study examines the organizational factors that influenced the attrition of special education teachers in one Central Florida school district.

Participation in the anonymous survey was voluntary. Invitations to participate were sent directly to 385 special education instructional personnel and distributed to all district personnel using an e-mail forum. After removing participants who did not meet the inclusion criteria, 250 completed surveys were included in the analysis. In addition to quantitative items, the survey also included open-ended items at the end of the survey. While special education instructional personnel were the focus of the study, data from general education instructional personnel were also collected for comparison.

The findings indicated that the major organizational causes of attrition among exceptional education teachers were in the areas of the human resources, political and structural frames. Human resource factors included the emotional, physical, and mental toll of daily classroom responsibilities and the perceived lack of district administration support. The main structural frame factor was the lack of compensation for the extra duties that special education teachers must perform. The main political factor was the lack of time needed by the special education staff to complete assigned duties during an average school day. In addition, the symbolic frame factors suggested a lack of perceived support from the general education staff; however, respondents did not indicate that this was major factor affecting in the attrition of special education teachers in this district.

The school district has implemented strategies to support teachers to meet State certification requirements, Federal mandates of being highly qualified,
and with monthly district level support visits. However, based on these data, the school district needs to recognize organizational factors affecting attrition. The district should pinpoint and alleviate the daily factors that cause undue stress on the special education staff. It should also reallocate resources and personnel to provide more frequent district and school level administrative support. Additional monetary or non-monetary compensation for the extra duties or reducing the workload on the special education teachers may also reduce attrition.

Committee: David Boote (Chair), Mary Little, Thomas Vitale, and Grant Hayes

Graduated Summer 2015
A Case Study Evaluation of Quality Standards and Online Faculty Development

ERIN O’BRIEN
Education EdD

This dissertation in practice was designed to provide an evaluation case study of two institutions, one college and one university, in the field of online learning and quality assurance. The writer evaluated these two institutions of higher learning to discover what online teaching criteria are required and what quality assurance processes are being used to assess the quality of the institutions’ online courses.

An analysis of the data revealed that both institutions were at the appropriate stage of development, support, training and quality assurance measures for their sizes, online populations and for the length of time they have been involved in online learning.

Findings revealed that both institutions had a quality assurance process in place that is appropriate to their location, population and faculty. There is much to be learned by examining the two different credentialing and quality assurance approaches to online teaching and learning that these two different institutions employ for anyone interested in improving their institutions’ processes.

Committee: Glenda Gunter (Chair), Richard Hartshorne, Kelvin Thompson, Thomas Vitale, and Dorothy Haggerty

Graduated Summer 2015
Classroom Error Climate: Teacher Professional Development to Improve Student Motivation

SEAN O’DELL
Education EdD

Student motivation and achievement are often low for students from low socioeconomic status households and may decline when children from all walks of life enter middle school. Despite years of studies describing these declines and efforts to improve learning outcomes, the trends continue. Motivation has been studied from several theoretical standpoints, among them, self-efficacy, beliefs, goal orientations, and emotions. This dissertation introduces error orientation: how teachers and students react to and use errors in the classroom. A positive error orientation, one that views errors as opportunities to learn rather than punishments, may help improve students’ emotions, self-efficacy, and future goal orientations, while aligning their beliefs in a more adaptive direction, thus reducing maladaptive academic motivation. A professional development design is proposed here to train teachers in using errors to the advantage of the learner by creating a positive error climate in their classrooms.

Committee: Michele Gill (Chair), Thomas Cox, Bobby Hoffman, and Jacquelyn Flanigan

Graduated Summer 2015
An Applied Organizational Analysis of School Factors Affecting Technology Integration within the Context of Literacy Instruction

D’ANN RAWLINSON
Education EdD

The purpose of this Dissertation in Practice was to analyze the organizational factors affecting technology integration within the context of literacy instruction at a single school site that was preparing to implement a 1:1 mobile device initiative in all K-5 classrooms the following academic year. This was achieved through conducting an organizational analysis using a multi-frame model developed by Bolman and Deal (2008).

This study used a convergent parallel mixed methods research design consisting of teacher and administrator interviews, a quantitative and qualitative survey, and classroom observational data. One main evaluation question was designed to frame this organizational analysis: What organizational factors support and impede technology integration within the context of literacy instruction? To answer the main evaluation question, the evaluator collected data to answer six evaluation sub-questions. The evaluation sub-questions were developed to ensure that data was being collected among Bolman and Deal’s (2008) four frames.

In the context of integrating technology into literacy instruction, the data collected in this study suggest that the organizational strategies and issues within the human resource frame are impacting, and are impacted by, the organization’s political, structural, and symbolic practices. The teachers’ lack of opportunities to develop the requisite knowledge, experience, and skills needed to integrate technology into literacy instruction seem to have impacted the teachers’ level of technology integration as well as their levels of concern. Data from this organizational analysis indicated that the lack of time was a major obstacle in learning how to integrate mobile devices into literacy instruction. The school’s current team-based organizational model, while supporting other aspects of their education practices, may create structural and political barriers to effectively implement the 1:1 mobile device initiative. Observations and interviews suggested that the school values technology to support basic literacy skills, but not the transformative role of technology on literacy in today’s society.
Using all four frames of the Bolman and Deal’s (2008) model allows an organization to look beyond one frame, such as developing human resources through professional development, when working towards implementing a school-wide initiative effectively. Although tailored professional development is necessary for teachers to learn how to integrate technology into literacy instruction, the professional development will not be effective without greater stability in the instructional staff, and focused political and structural solutions that will support the instructional staff’s professional learning and implementation.

Committee: David Boote (Chair), Vassiliki Zygouris-Coe, Mary Little, George Pawlas, and Cherie Behrens

Graduated Fall 2015
Examining Practices of Elementary School Principals: Selection of Co-teaching Teams

JEANNETTE TEJEDA
Education EdD

The purpose of this study was to explore the lived experiences of urban elementary school principals in relation to co-teaching and their co-teacher selection process. Three elementary school principals who exemplify characteristics of shared, ethical, and transformational leadership from a large urban school district in the southern United States were interviewed. The findings from the interviews were utilized to create a Likert-type survey to be administered to select co-teachers and select teachers not co-teaching at each of the three schools. The interview data were examined using Hycner’s guidelines for phenomenological analysis. The Likert-type surveys administered to co-teachers and teachers not co-teaching served as sources of information for triangulation. The findings of the study led to the emergence of 13 themes addressing the three research questions. The resulting themes were (a) open communication with staff, (b) team approach to decision-making, (c) teacher leadership, (d) parental involvement encouraged, (e) positive relationship with staff, (f) professional growth encouraged, (g) volunteers selected for co-teaching, (h) co-teachers select partners, (i) co-teaching option presented to entire teaching staff, (j) personal involvement in co-teaching selection process, (k) multifaceted selection criteria, (l) principals involved teachers in the pairing procedure, and (m) recruitment procedures were aligned with best practices. This study has contributed additional evidence supportive of best practices in co-teaching and leadership and suggests a link between effective leadership practices and the facilitation of co-teaching teams and co-teacher selection processes. Recommendations for future research address the areas of (a) principal experience, (b) length of co-teaching model, (c) principal personal involvement, (d) study participant size, (e) study subjects, and (f) link between leadership practices and co-teaching selection procedures.

Committee: Suzanne Martin (Chair), Maria Reyes, Lisa Dieker, and Karen Uhle

Graduated Fall 2015
Changes in the demands on educational leaders have necessitated shifts in the roles and responsibilities of school principals. Meeting the needs of students with disabilities is among the critical challenges that administrators face today. The purpose of this study was to examine the lived experiences of elementary school principals where students with Specific Learning Disabilities (SLD) demonstrate reading proficiency. Phenomenological research was conducted to identify the themes associated with effective school leadership, related to this specific population, students with SLD. Informal, non evaluative observations were conducted in conjunction with analysis of leadership summaries that were submitted by teachers who were nominated by the participants, to determine theme congruence.

These results indicated that the lived experiences of elementary school principals are a complex blend of characteristics and practices. Seven specific themes were identified in the qualitative interviews: 1) Embedded personal and/or professional experiences; 2) Adaptability; 3) Relationship orientation and commitment to collaboration; 4) Focused responsibility and accountability; 5) Hiring and supporting teachers while maintaining a culture of high expectations; 6) Resource allocation; 7) Reflection that informs decision making. This research provided preliminary evidence to demonstrate the lived experiences of elementary school principals, with a particular focus on students with SLD, and can be used to inform and adapt current practices to address anticipated challenges in the future.

Committee: Suzanne Martin (Chair), Mary Little, Martha Lue, and Maria Vazquez

Graduated Fall 2015
The Effect of a Metalinguistic Approach to Sentence Combining on Written Expression in Eighth Grade Science for Students Who Struggle with Literacy

LYNNE TELESCA
Education PhD - Communication Sciences and Disorders

Recent data indicate that less than 50% of American secondary students are able to demonstrate grade-level proficiency in reading, writing, and science (National Center for Educational Statistics [NCES], 2007, 2011, 2012a, 2012b). Secondary students’ are expected to develop advanced literacy skills, especially in writing, in order to be ready for college and careers. Students are expected to develop these advanced literacy skills, within all academic subjects. In other words, they are expected to develop disciplinary literacy skills. The statistics are alarming overall, but they are particularly alarming in the area of science. Students need strong literacy skills, including written expression, to be prepared for employment opportunities in science fields, which currently are being filled by graduates of other industrialized nations, who have a more advanced skill set. This loss of occupational opportunity poses a threat for the U.S. to remain globally competitive in science innovation and advancement, which ultimately secures economic prosperity. Despite these staggering concerns, there is little research conducted to evaluate effective instructional methods to develop complex writing skills in academic disciplines such as science.

To address this critical issue, the present study examined the effects of a metalinguistic approach to the writing intervention of sentence combining with eighth-grade students who struggle with literacy. The researcher conducted the study in a typical science classroom in an urban American school setting. The focus of the intervention was to increase students’ metalinguistic awareness of science text, to improve written sentence complexity in science, as well as the written expression and determination of comparison and contrast of science content. The study employed a quasi-experimental design. The participants consisted of an experimental group (two classes) who received the treatment during typical science instruction and a comparison group (three classes) who did not receive treatment, but participated in their typical science instruction. There were four participating teachers and 84 participating students. The researcher conducted the study
over a period of seven weeks within regularly scheduled science classes. Twenty intervention sessions were conducted for a length of 20 minutes each, totaling 400 minutes or 6.6 hours.

Hierarchical repeated measures ANOVA and hierarchical repeated measures MANOVA analyses revealed that the experimental group performed significantly better than the comparison group on their ability to determine similarities and differences (compare and contrast) related to science content, with a medium effect. The experimental group achieved a slightly higher marginal mean over the comparison group on their ability to combine sentences, with a small effect. Multiple statistical analyses revealed a trend of higher marginal means in favor of the experimental group over the comparison group on several measures of written sentence complexity on both the science compare and contrast writing prompt (small-medium effect) and the science expository essay (medium to large effect). One experimental class also demonstrated higher scores in their overall sentence correctness on science expository essay as compared to all the other classes.

These findings suggest that sentence combining, utilizing a metalinguistic approach, may hold promise as an effective writing intervention in a content area classroom, for secondary students who struggle with literacy. Furthermore, the findings suggest that a metalinguistic approach to sentence combining can be successfully embedded within a content area class, which may result in increased concept knowledge and writing skills in that academic discipline. Implications for practice and future research directions are discussed.

Committee: Barbara Ehren (Chair), Vassiliki Zygouris-Coe, Anthony Pak Hin Kong, and Debbie Hahs-Vaughn

Graduated Summer 2015
The Helping Professional Wellness Discrepancy Scale (HPWDS): Development and Validation

ASHLEY BLOUNT

Education PhD - Counselor Education

Wellness is an integral component of the helping professions (Myers & Sweeney, 2005; Witmer, 1985). Specifically, wellness is included in ethical codes, suggestions for practice, and codes of conduct throughout counseling, psychology, and social work fields (see American Counseling Association Code of Ethics, 2014; American Psychological Association Ethical Principles of Psychologists and Code of Conduct, 2010; National Association of Social Workers Code of Ethics, 1996). Even so, wellness in helping professionals is a difficult construct to measure. Thus, the purpose of the research investigation was to develop the Helping Professional Wellness Discrepancy Scale (HPWDS) and examine the psychometric features of the HPWDS in a sample of helping professionals and helping professionals-in-training. A correlational research design was employed for this investigation (Gall, Gall, & Borg, 2007). Specifically, the researcher examined: (a) the factor structure of the HPWDS with a sample of helping professionals; (b) the internal consistency reliability of the HPWDS; (c) the relationship between HPWDS scores and Counseling Burnout Inventory (CBI) scores; (d) the relationships between helping professionals’ HPWDS scores and their reported demographic data; and (e) the relationship between HPWDS factor scores and the Marlowe-Crowne Social Desirability Scale-X1 (MCSDS-X1). The research questions were examined using: (a) Factor Analysis (FA), (b) Cronbach’s alpha, (c) Spearman Rho correlation, (d) Multiple Linear Regression (MLR) and (e) internal replication analysis.

A review of the literature is provided, discussing theoretical and empirical support for all the items on the initial model of the HPWDS (n = 92) as well as for all the items included on the final HPWDS exploratory model (n = 22). The researcher investigated helping professionals’ perceived levels of wellness, aspirational levels of wellness, and the discrepancy between perceived and aspirational levels of wellness. The data was collected via online, mail out, and face-to-face administration to increase methodological rigor. The sample size for the investigation was 657, with 88 coming from Face-to-Face sampling, 87 from mail out sampling, and 484 from online/email sampling. Data analysis resulted in a five-factor exploratory
HPWDS model that accounted for 69.169% of the total variance. Model communalities were considered acceptable with only three communalities below the recommended .5 value. Factor 1 represented Professional & Personal Development Activities and accounted for 32.605% of the variance, Factor 2 represented Religion/Spirituality and accounts for 13.151% of the variance, Factor 3 represented Leisure Activities and accounted for 9.443% of the variance, Factor 4 represented Burnout and accounted for 7.198% of the variance, and Factor 5 represented Helping Professional Optimism and accounted for 6.773% of the variance.

In addition to a literature review, the research methodology and research results are provided. Results of the research investigation are discussed and areas for future research, limitations of the study, and implications for the helping professions are presented. Some implications of the findings include: (a) a theoretically and methodologically sound instrument for assessing wellness discrepancies in helping professionals is important; (b) helping professionals should be aware of both the personal and professional activities they are engaging in to increase their knowledge and self-efficacy, as well as their leisure activity engagement; (c) it is advantageous for researchers to use the scale development procedures, rigorous sampling methodologies, and FA guidelines outlined throughout Chapters 3 and 4 when developing new assessments for evaluating helping professionals; and (d) a five factor wellness assessment allowing helping professionals to evaluate themselves in Professional & Personal Development Activities, Religion/Spirituality, Helping Professional Optimism, Leisure Activities, and Burnout arenas is integral in assessing wellness discrepancies in helping professionals.

Committee: Glenn Lambie (Chair), Mark Young, Dalena Taylor, and Richard Ricard

Graduated Spring 2015
A Phenomenological Investigation of the Lived Experiences of African American Adults in Individual Mental Health Counseling

JESSICA MARTIN

*Education PhD – Counselor Education*

**Background:** African Americans continue to access non-emergency mental health care at a lower rate than White Americans, despite having equal risk for mental health issues. Currently, literature in counseling focuses on this deficit and why African Americans do not attend counseling, as opposed to those African Americans who do choose to go into counseling.

**Purpose:** The purpose of this study is to investigate the lived experiences of African American adults who have engaged in mental health counseling. This study also seeks to add a counter-narrative to the current counseling literature by focusing on the experiences of African Americans who engage in counseling as opposed to those who do not.

**Setting:** Participants were recruited from two counseling clinics in the Orlando, FL area and through snowballing by asking participants and other mental health community partners and professors.

**Subjects:** Six African American women were selected to be in this study based on the inclusion criterion of: (a) self-identify as African American or Black, (b) are over the age of 18 and (c) currently participate in outpatient, individual mental health counseling and have completed at least three counseling sessions.

**Research Design:** A heuristic phenomenological research design was used to answer the research questions for this study.

**Data Collection and Analysis:** Data for this study were collected through audio recorded face-to-face interviews, a demographics questionnaire and researcher field notes. The interviews were transcribed and hand coded for emergent themes.

**Findings:** This study found that the participants approached counseling as a result of going through a personally traumatic event. All participants
experienced some level of stigma toward counseling from family and friends, due to doing something that is considered counter-culture or from fear of being labeled. Study participants also noted that one of the most important aspects that they looked for in a counselor was professionalism. Lastly, through the experience of attending counseling study participants found that counseling helped them to find a level of acceptance for their own perceived flaws and the perceived flaws in other people.

Conclusions: This study provides a counter-narrative that can inform counselors and counselor educators about the experience African Americans have while being in counseling. This counter-narrative demonstrates that African Americans who engage in counseling still deal with some of the stigmas that non-attendees deal with but that counseling can provide a place where they gain acceptance and coping skills for dealing with traumatic events in their lives.

Committee: David Boote (Chair), Gulnora Hundley, Edward Robinson, and Carolyn Hopp

Graduated Summer 2015
A Quasi-Experiment Examining Expressive and Receptive Vocabulary Knowledge of Preschool Head Start Children Using Mobile Media Apps

ANGELA VATALARO
Education PhD - Early Childhood

The American Academy of Pediatrics (1999, 2011) recommends no screen time for children under two years and limited screen time for three- and four-year-olds. Despite these recommendations, most young children have easy access to various types of screens. In particular, children’s use of mobile media, including tablets and other touch screen devices, is increasing (Common Sense Media, 2013). Even though scholars have highlighted positive uses for mobile media (Christakis, 2014; Radesky, Schumacher, & Zuckerman, 2015) and there are recommendations in place for using mobile media with young children in active, open-ended ways (NAEYC & Fred Rogers Center, 2012), there has been very limited research conducted on the impact of mobile media on young children’s development. What is more, as early childhood professionals are beginning to incorporate mobile media into their classrooms, they are struggling with the ability to use these devices in developmentally appropriate ways (Marklund, 2015; Nuttall, Edwards, Mantilla, Grieshaber, & Wood, 2015).

The primary purpose of the present study was to examine the efficacy of using different types of mobile media apps to increase the receptive and expressive vocabulary development of preschool children living in economically disadvantaged communities. Children and teachers in four Head Start classrooms participated in the quasi-experimental study, which included an eight-week intervention in which the children interacted with one of two types of apps: one classroom used direct instruction vocabulary apps \((n = 16)\) and one classroom used open-ended vocabulary apps \((n = 15)\). Two classrooms served as control groups \((n = 18; \ n = 14)\) which used apps that were chosen by the Head Start program with no specific instructional method. Children’s vocabulary was assessed pre- and post-intervention. To assess receptive vocabulary, the PPVT-4 (Dunn & Dunn, 2007) and an iPad Receptive Vocabulary Assessment (Vatalaro, 2015a) were used. To assess expressive vocabulary, the EVT-2 (Williams, 2007) and an iPad Expressive Vocabulary Assessment (Vatalaro, 2015b) were used. Using a repeated measures analysis of variance with split plot analysis, children who used...
direct instruction apps performed statistically significantly higher on the PPVT-4 than children who used open-ended apps. Children in the direct instruction app group also performed statistically significantly higher than both control groups on the iPad Receptive Vocabulary Assessment. There were no statistically significant differences between groups for receptive vocabulary as measured by the EVT-2. However, when children were credited for describing a function instead of the iPad vocabulary word, the analysis of the iPad Expressive Vocabulary Assessment revealed that the children using direct instruction apps performed statistically significantly higher than children using open-ended apps and the children in one of the control groups.

A secondary purpose of the present study was to examine the use of apps in mobile media by Head Start teachers. The teachers in the two intervention classrooms participated in weekly meetings with the primary researcher for support in using mobile media in their classrooms in order to ensure that the child intervention was carried out with fidelity. After analyzing data from teachers’ self-report daily logs across the eight-week intervention, it was determined that the children received instruction on the assigned apps in both intervention classrooms.

Although caution is given to the findings due to some limitations such as the quasi-experimental choice of a research design and the number of participants, the present study contributed to the early childhood research literature with the findings that interactive, animated apps which provide the meanings of vocabulary words in a direct instruction manner may have the ability to increase a child’s receptive vocabulary, and to increase a child’s descriptive definitions of iPad functions. This information increases the chance that teachers in Head Start will begin using direct instruction apps, in the hope of increasing a child’s vocabulary knowledge.

Committee: Anne Culp (Chair), Judit Szente, Debbie Hahs-Vaughn, Judith Levin, and Jill Goodman

Graduated Summer 2015
Literate Citizenship: The Culture of Literacy in Inclusive Middle School Social Studies Classrooms and Students with Intellectual Disabilities

KATHLEEN BECHT
Education PhD - Exceptional Education

As more and more students with intellectual disabilities are included in the general education middle school setting, the culture and context of the literacy instruction they are receiving is severely limited in the existing literature. In this study, the researcher employed an ethnographic research design to observe the literacy culture of two middle school general education social studies teachers in the context of a district and school that had focused on more inclusive practices over the past five years. The learning environment and the general education teachers’ perceptions and expectations of the nature of literacy for students with intellectual disabilities in the general education setting were observed over a nine week period using two theoretical frameworks; the culture of inclusion (Giangreco, Cloninger, Dennis, & Edelman, 1994) and socio-cultural literacy (Barton & Hamilton, 1998). The data gathered is reflective of the literacy practices used with the four students with intellectual disabilities who agreed to participate in the in-depth analyses, though nine were enrolled in the three general education classes. The themes of socialization for students with intellectual disabilities in general education classes, and the immersion in and isolation from literacy practices within the general education social studies literacy culture emerged and are discussed in detail. Implications for practice and recommendations for future research for students with intellectual disabilities in general education middle school settings are provided.

Committee: Lisa Dieker (Chair), Wilfred Wienke, Mary Little, and Vassiliki Zygouris-Coe

Graduated Summer 2015
Effects of a Mathematics Graphic Organizer and Virtual Video Modeling on the Word Problem Solving Abilities of Students with Disabilities

LAUREN DELISIO
Education PhD - Exceptional Education

Over the last decade, the inclusion of students with disabilities (SWD) in the general education classroom has increased. Currently, 60% of SWD spend 80% or more of their school day in the general education classroom (U.S. Department of Education, 2013). This includes students with autism spectrum disorders (ASD), a developmental disability characterized by impairments in behavior, language, and social skills (American Psychological Association, 2013).

Many of these SWD struggle with mathematics in the elementary grades; fewer than 20% of SWD are proficient in mathematics when they begin middle school, compared to 45% of their peers without disabilities. Furthermore, 83% of SWD are performing at the basic or below basic level in mathematics in the fourth grade (U.S. Department of Education, 2013). As the rate of ASD continues to increase (Centers for Disease Control, 2013), the number of students with this disability who are included in the general education classroom also continues to rise. These SWD and students with ASD are expected to meet the same rigorous mathematics standards as their peers without disabilities. This study was an attempt to address the unique needs of SWD and students with ASD by combining practices rooted in the literature, strategy instruction and video modeling.

The purpose of this study was to determine the effects of an intervention on the ability of students with and without disabilities in inclusive fourth and fifth grade classrooms to solve word problems in mathematics. The intervention package was comprised of a graphic organizer, the K-N-W-S, video models of the researcher teaching the strategy to a student avatar from a virtual simulated classroom, TeachLivE™, and daily word problems for students to practice the strategy. The researcher used a quasi-experimental group design with a treatment and a control group to determine the impact of the intervention. Students were assessed on their performance via a pretest
and posttest. Analyses of data were conducted on individual test items to assess patterns in performance by mathematical word problem type.

The effects of the intervention on SWD, students with ASD, and students without disabilities varied widely between groups as well as amongst individual students, indicating a need for further studies on the effects of mathematics strategy instruction on students with varying needs and abilities.

Committee: Lisa Dieker (Chair), Eleazar Vasquez, Rebecca Hines, and Juli Dixon

Graduated Summer 2015
The Effect of Training Volume and Intensity on Improvements in Muscular Strength and Size in Resistance-trained Men

GERALD MANGINE

Education PhD - Exercise Physiology

The magnitude of improvements in muscular strength and size are influenced by the volume and intensity of a resistance training program. While it is clearly advantageous for resistance-trained individuals to utilize programming specific to these goals, it is not clear which is more important. Therefore, the purpose of the present investigation was to determine the effect of focusing on training volume versus intensity on changes in muscle size and strength. Changes in muscular strength and size were examined in 29 resistance-trained men following 8 weeks of resistance training. Participants were randomly assigned to either a high volume (VOL, n = 14, 4 x 10 – 12RM, 1min rest) or high intensity (INT, n = 15, 4 x 3 – 5RM, 3min rest) resistance training program. Lean body mass, lean arm and leg mass, were assessed by dual energy X-ray absorptiometry, while ultrasound images (VL-vastus lateralis, RF-rectus femoris, PM-pectoralis major, and TB-triceps brachii) were used to assess changes in muscle cross-sectional area (CSA) and thickness (MT). Strength was measured by one repetition-maximum (1RM) squat (SQ) and bench press (BP). Changes in muscular (RF & VL) activation in response to increases in submaximal SQ intensity (40-, 60-, 80-, & 100%-1RM) were assessed via surface electromyography. Blood samples were collected at baseline, immediately post, 30min post, and 60min post-exercise at week 3 (WK3) and week 10 (WK10), to assess plasma/serum testosterone, growth hormone (GH), insulin-like growth factor-1 (IGF1), cortisol (CORT), and insulin. Area under the curve analysis revealed a greater (p < 0.05) increase for VOL (WK3: GH & CORT; WK10: CORT) compared to INT. Compared to WK3, WK10 showed reduced responses for VOL (GH and CORT) and INT (IGF1). Significant group differences were observed for changes in lean arm mass (INT: 5.2 ± 2.9%, VOL: 2.2 ± 5.6%) and BP 1RM (INT: 14.8 ± 9.7%, VOL: 6.9 ± 9.0%). Over the course of 8 weeks, our data indicate that trained men would benefit
more when focusing on training intensity, rather than volume, for strength and size improvements.

Committee: Jay Hoffman (Chair), David Fukuda, Jeffrey Stout, and Nicholas Ratamess

Graduated Spring 2015
Acute Pro-inflammatory Immune Response Following Different Resistance Exercise Protocols in Trained Men

ADAM WELLS
Education PhD - Exercise Physiology

The successful regeneration of muscle tissue is dependent upon the infiltration of phagocytic CD14++CD16− monocytes that support the proliferation and differentiation of myogenic precursor cells. Physiologically, the magnitude of the cellular response following resistance exercise is dictated by the level of receptor expression on the plasma membrane of the monocyte, as well as the secretion of their cognate ligands from tissue resident cells. However, it remains unclear whether the innate pro-inflammatory immune response varies with different resistance training protocols, and how it may impact recovery and the muscle remodeling process. Therefore, the purpose of this investigation was to examine temporal changes in the expression of chemotactic and adhesion receptors following an acute bout of high-volume, moderate-intensity (VOL) versus high-intensity, low-volume (HVY) lower-body resistance exercise in experienced, resistance trained men. Changes in receptor expression were assessed in conjunction with plasma concentrations of MCP-1, TNFα, and cortisol.

Ten resistance-trained men (90.1 ± 11.3 kg; 176.0 ± 4.9 cm; 24.7 ± 3.4 yrs; 14.1 ± 6.1% body fat) performed each resistance exercise protocol in a random, counterbalanced order. Blood samples were obtained at baseline (BL), immediately (IP), 30 minutes (30P), 1 hour (1H), 2 hours (2H), and 5 hours (5H) post-exercise. Analysis of target receptor expression on CD14++CD16− monocytes was completed at BL, IP, 1H, 2H and 5H time points via flow cytometric analysis. Plasma concentrations of myoglobin, and LDH AUC were significantly greater following HVY compared to VOL ($p = 0.003$ and $p = 0.010$ respectively). Changes in plasma TNFα, MCP-1, and expression of CCR2, CD11b, and GCR on CD14++CD16− monocytes were similar following HVY and VOL. When collapsed across groups, TNFα was significantly increased at IP, 30P, 1H and 2H post-exercise ($p = 0.001 – 0.004$), while MCP-1 was significantly elevated at all post-exercise time points ($p = 0.002 – 0.033$). CCR2 expression was significantly lower at IP, 1H, 2H and 5H post-exercise ($p = 0.020 – 0.040$). In contrast, CD11b receptor expression was significantly greater at 1H relative to BL ($p = 0.001$), while GCR expression was not significantly different from baseline at any
time point. As expected, plasma cortisol concentrations were significantly higher following VOL compared to HVY ($p = 0.001$), although this did not appear to be related to changes in receptor expression. Plasma testosterone concentrations and TNFr1 receptor expression did not appear to be affected by resistance exercise. Our results do not support a role for cortisol in the modulation of CCR2 receptors in vivo, while the degree of muscle damage does not appear to influence plasma concentrations of TNFα, or MCP-1. It is therefore likely that both HVY and VOL protocols constitute an exercise stimulus that is sufficient enough to promote a robust pro-inflammatory response, which is similar in timing and magnitude.

Committee: Jay Hoffman (Chair), Jeffrey Stout, David Fukuda, and Leonardo Oliveira

Graduated Spring 2015
Fostering College Student Success: An Analysis of the Educational Outcomes of Florida College Students Receiving Relative Caregiver, Road-to-Independence, and Adoption Tuition Exemptions

LAUREN MURRAY-LEMON
Education PhD - Higher Education

This study investigated the educational outcomes of foster care youth utilizing the Road to Independence, Adopted from DCF, and Relative Caregiver tuition exemptions to pursue enrollment in Florida’s state college system during the 2012-2013 academic year. An extensive literature review was conducted to examine the history of foster care, examine a contemporary portrait of the American foster care system, and the adult outcomes of former foster care. Federal and state policies impacting the population, campus support initiatives at colleges nationwide and the concept of resilience were also explored.

In conjunction with the Florida Department of Education's Division of Accountability, Research and Measurement, the Florida Department of Children and Families provided access to a dataset compiled by the Community College and Technical Center MIS department. This file contained enrollment information for foster care youth utilizing one of three tuition exemptions to fund their education-related expenses. While all personal identifiers were eliminated prior to sharing the file, information within the document included student age, gender, race/ethnicity, academic discipline, and degree being pursued.

Results of this study yielded some statistically significant differences across tuition exemption type. After examining relationships between gender and race/ethnicity and tuition exemption type, no statistically significant results were found. However, statistical significance was found after examining the relationships between academic degree being pursued and academic major/discipline and tuition exemption type. Many factors impact the experiences of foster care youth in the college classroom. These should be considered
when developing programming, policy, and support services aimed at encouraging their success.

Committee: Thomas Cox (Chair), Michael Preston, JoAnn Whiteman, and Olga Molina

Graduated Fall 2015
Conditions Associated with Increased Risk of Fraud: A Model for Publicly Traded Restaurant Companies

ELIZABETH YOST
Education PhD - Hospitality Education

The central focus of this dissertation study is to understand the impact of the Sarbanes-Oxley Act and the factors that contribute to increased risk of fraud in order to determine why fraud may occur despite the imposed regulation of the Sarbanes-Oxley Act. The main premise of the study tests the application of the fraud triangle framework constructs to publicly traded restaurant companies during the time period of 2002-2014, using proxy variables defined through literature. Essentially, the study seeks to identify the factors that may provide the optimal criteria to engage in fraudulent or opportunistic behavior. The fraud triangle theoretical framework is comprised of the constructs of pressure, opportunity and rationalization, and has mostly been utilized by external auditors to assess the fraud risk of various companies. It has never been applied to the restaurant industry, and the proxy variables selected have never before been tested in a comprehensive model. Thus, a major contribution of this study may enable executive managers to assess the fraud triangle conditions according to the model in order to afford conclusions regarding increased risk of fraud.

The study first hypothesized that the Sarbanes-Oxley Act has had a significant impact on detecting increased risk of fraud for publicly traded restaurant companies. Additionally, the study controlled for and tested the proxy variables of the fraud triangle constructs to determine if any of the variables had a significant impact on detecting increased risk of fraud for publicly traded restaurant companies. The variables tested included company size, debt, employee turnover, organizational structure, international sales growth, executive stock compensation, return on assets, the Recession, and macro-economic factors of interest, inflation, and unemployment rates.

The research study adopted an exploratory research design using the case of publicly traded United States restaurant companies in order to provide a better understanding of the characteristics that may contribute to increased fraud risk. The study assumed a binary distribution of the dependent variable, increased fraud risk, measured by the incidence of a reported internal control
deficiency over the testable time period. Specifically, the study employed a probit model to estimate the probability that an entity or company will be at an increased risk of fraud based on the independent variables that support and are linked to the fraud triangle framework. Additionally, the model assumes equal weight to the variables of the fraud triangle framework.

Through use of the probit model, the major findings of the study were as follows: First, the Sarbanes-Oxley Act does have a significant impact on highlighting areas of increased fraud risk for publicly traded restaurant companies. Second, for the total population of restaurant companies, only the Recession, interest rates, inflation rates and unemployment rates are significant indicators of increased fraud risk. None of the internal variables were significant. However, once the data was segmented by type of restaurant, the results revealed significance of both internal and external variables.

These results imply a couple of theoretical notions: first, that the Sarbanes-Oxley Act is an effective means for detecting risk of fraud for publicly traded restaurant companies when considering variables that support the fraud triangle; second, that the fraud triangle is contextual when applied to the restaurant industry because only the variables that are outside of managements control were significant. Finally, from a managerial perspective, the study provides evidence that macro-economic conditions that might affect consumer demand may increase the risk of fraud for publicly traded restaurant companies.

Committee: Robertico Croes (Chair), Denver Severt (Co-Chair), Edward Robinson, Kevin Murphy, Kelly Semrad, and Leonard Jackson

Graduated Spring 2015
Grounding Design of Instruction: An Exploration of the Uses of Scientific-based Research and Theory in the Design of Online Instruction by Faculty in Higher Education

JAPHETH KOECH
Education PhD - Instructional Technology

This study was conducted to explore the processes educators in higher education used to ground their design of online instruction using scientific-based research and theory. Literature reviewed suggested reasons educators fail to ground the design of instruction were a lack of formal training in instructional methods, skills, support, and research understanding. The rationale for the study was to (a) increase understanding of how educators use scientific research and theory as a basis in decision-making during design and creation of online instruction, (b) identify best practices, and (c) add to the conversation in the instructional design field.

A qualitative case study research design was utilized to interview, review course, and review documents of four participants to capture their viewpoints as to the (a) meaning of; (b) evidence; (c) step by step processes; and (d) problems associated with the processes of grounding the design of online instruction in scientific-based research and theory. Data obtained were analyzed through detailed case description, direct interpretation, cross-case analysis, pattern establishment, and naturalistic generalization. Pedagogy, instructional design, instructional technology, support, and problems emerged as key thematic issues.

Findings suggested that although educators were consistent in defining meaning, followed step-by-step processes, and had evidence to support their decisions, they encountered logistical challenges of time, technology and design in the process of using scientific-based research and theory to ground the design of online instruction. The implications for practice from this research were similar to recommendations of other researchers. For this
process to be smoother, regular training, peer professional interactions, and support must be present.

Committee: Glenda Gunter (Chair), Lihua Xu, Richard Hartshorne, and Erhan Haciomeroglu

Graduated Summer 2015
Modeling Autocorrelation and Sample Weights in Panel Data: A Monte Carlo Simulation Study

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PARUL ACHARYA

Education PhD - Methodology, Measurement and Analysis

This dissertation investigates the interactive or joint influence of autocorrelative processes (autoregressive-AR, moving average-MA, and autoregressive moving average-ARMA) and sample weights present in a longitudinal panel data set. Specifically, to what extent are the sample estimates influenced when autocorrelation (which is usually present in a panel data having correlated observations and errors) and sample weights (complex sample design feature used in longitudinal data having multi-stage sampling design) are modeled versus when they are not modeled or either one of them is taken into account. The current study utilized a Monte Carlo simulation design to vary the type and magnitude of autocorrelative processes and sample weights as factors incorporated in growth or latent curve models to evaluate the effect on sample latent curve estimates (mean intercept, mean slope, intercept variance, slope variance, and intercept slope correlation). Various latent curve models with weights or without weights were specified with an autocorrelative process and then fitted to data sets having either the AR, MA or ARMA process. The relevance and practical importance of the simulation results were ascertained by testing the joint influence of autocorrelation and weights on the Early Childhood Longitudinal Study for Kindergartens (ECLS-K) data set which is a panel data set having complex sample design features.

The results indicate that autocorrelative processes and weights interact with each other as sources of error to a statistically significant degree. Accounting for just the autocorrelative process without weights or utilizing weights while ignoring the autocorrelative process may lead to bias in the sample estimates particularly in large-scale datasets in which these two sources of error are inherently embedded. The mean intercept and mean slope of latent curve models without weights was consistently underestimated when fitted to data sets having AR, MA or ARMA process. On the other hand, the intercept variance, intercept slope, and intercept slope correlation were overestimated for latent curve models with weights. However, these three estimates were not accurate as the standard errors associated with them were high. In addition, fit indices, AR and MA estimates, parsimony of the
model, behavior of sample latent curve estimates, and interaction effects between autocorrelative processes and sample weights should be assessed for all the models before a particular model is deemed as most appropriate. If the AR estimate is high and MA estimate is low for a LCAR model than the other models that are fitted to a data set having sample weights and the fit indices are in the acceptable cut-off range, then the data set has a higher likelihood of having an AR process between the observations. If the MA estimate is high and AR estimate is low for a LCMA model than the other models that are fitted to a data set having sample weights and the fit indices are in the acceptable cut-off range, then the data set has a higher likelihood of having an MA process between the observations. If both AR and MA estimates are high for a LCARMA model than the other models that are fitted to a data set having sample weights and the fit indices are in the acceptable cut-off range, then the data set has a higher likelihood of having an ARMA process between the observations. The results from the current study recommends that biases from both autocorrelation and sample weights needs to be simultaneously modeled to obtain accurate estimates. The type of autocorrelation (AR, MA or ARMA), magnitude of autocorrelation, and sample weights influences the behavior of estimates and all the three facets should be carefully considered to correctly interpret the estimates especially in the context of measuring growth or change in the variable(s) of interest over time in large-scale longitudinal panel data sets.

Committee: Stephen Sivo (Chair), Debbie Hahs-Vaughn (Co-Chair), Eleanor Witta, and Malcolm Butler

Graduated Fall 2015
An Investigation of the Impacts of Face-to-Face and Virtual Laboratories in an Introductory Biology Course on Students’ Motivation to Learn Biology

AMBER REECE
Education PhD - Science Education

The objective of this study was to evaluate and compare the effects of face-to-face and virtual laboratories in a large-enrollment introductory biology course on students’ motivation to learn biology. The laboratory component of post-secondary science courses is where students have opportunities for frequent interactions with instructors and their peers (Seymour & Hewitt, 1997; Seymour, Melton, Wiese, & Pederson-Gallegos, 2005) and is often relied upon for promoting interest and motivation in science learning (Hofstein & Lunetta, 2003; Lunetta, Hofstein, & Clough, 2007). However, laboratory courses can be resource intensive (Jenkins, 2007), leading post-secondary science educators to seek alternative means of laboratory education such as virtual laboratories. Scholars have provided evidence that student achievement in virtual laboratories can be equal to, if not higher than, that of students in face-to-face laboratories (Akpan & Strayer, 2010; Finkelstein et al., 2005; Huppert, Lomask, & Lazarowitz, 2002). Yet, little research on virtual laboratories has been conducted on affective variables such as motivation to learn science.

Motivation to learn biology was measured at the beginning and end of the semester using the Biology Motivation Questionnaire © (Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011) and compared between the face-to-face and virtual laboratory groups. Characteristics of the two laboratory environments were measured at the end of the semester by the Distance Education Learning Environment Survey (Walker & Fraser, 2005). Interviews with 12 participants were conducted three times throughout the semester in the phenomenological style of qualitative data collection. The quantitative survey data and qualitative interview and observation data were combined to provide a thorough image of the face-to-face and virtual laboratory environments and their impacts on students’ motivation to learn biology.
Statistical analyses provided quantifiable evidence that the novel virtual laboratory environment did not have a differential effect on students’ motivation to learn biology, with this finding being supported by the qualitative results. Comparison of the laboratory environments showed that students in the face-to-face labs reported greater instructional support, student interaction and collaboration, relevance of the lab activities, and authentic learning experiences than the students in the virtual labs. Qualitative results indicated the teaching assistants in the face-to-face labs were an influential factor in sustaining students’ motivation by providing immediate feedback and instructional support in and out of the laboratory environment. In comparison, the virtual laboratory students often had to redo their lab exercises multiple times because of unclear directions and system glitches, potential barriers to persistence of motivation. The face-to-face students also described the importance of collaborative experiences and hands-on activities while the virtual laboratory students appreciated the convenience of working at their own pace, location, and time. According to social cognitive theory (Bandura, 1986, 2001), the differences in the learning environments reported by the students should have had ramifications for their motivation to learn biology, yet this did not hold true for the students in this study. Therefore, while these laboratory environments are demonstrably different, the virtual laboratories did not negatively impact students’ motivation to learn biology and could be an acceptable replacement for face-to-face laboratories in an introductory biology course.

Committee: Malcolm Butler (Chair), David Boote, Jacquelyn Chini, and Kenneth Fedorka

Graduated Summer 2015
A Quasi-Experimental Study on the Impact of Explicit Instruction of Science Text Structures on Eighth-Grade English Learners’ and Non-English Learners’ Content Learning and Reading Comprehension in Three Inclusive Science Classrooms

JELITZA RIVERA
Education PhD - Teaching English to Speakers of Other Languages

The focus of this quasi-experimental study was to examine the impact of explicit instruction of science comparison and contrast macro text structures plus micro text structures on the content learning, sentence comprehension, and reading comprehension of eighth-grade English Learners (ELs) and non-English Learners (non-ELs) in three inclusive science classrooms. Although the results of this study did not show significant differences between groups in sentence comprehension, reading comprehension, or science content learning, the treatment group increased and maintained their science content learning scores over time, while the scores of the comparison group declined from post-test to delayed post-test. In addition, the researcher sought to determine whether sentence combination scores were a predictor of reading comprehension scores. The results showed that sentence combination scores were good predictors for reading comprehension.

Committee: Vassiliki Zygouris-Coe (Chair), Joyce Nutta, Eleanor Witta, and Barbara Ehren

Graduated Summer 2015
Increasing Metalinguistics Awareness as a Necessary Precursor for Preservice Teachers

AIMEE SCHOONMAKER
Education PhD - Teaching English to Speakers of Other Languages

Metalinguistic awareness (MA) in the context of the present study is the ability to deconstruct and analyze a language’s intricate systems, and by doing so, better understand how these systems work. More specifically for the present study, the investigation focused on preservice teachers’ MA in relation to grammar and its importance for their future students’ understanding of language. Language is at the core of any content area in students’ academic lives and it will continue to permeate all aspects of their studies at all ages. As such, language-related issues should be at the front and center of preservice teachers’ preparation.

The present study, a quasi-experimental one-group pretest-posttest (Shadish, Cook & Campbell, 2002) investigated the metalinguistic awareness of preservice teachers who were enrolled in a face-to-face, undergraduate applied linguistics course at an urban research university in the United States. The metalinguistic awareness in the scope of the present study was directly related to the grammar knowledge of participants, and it was measured by an adapted instrument called ALAT.

The results of the current study demonstrate that overall increase of MA is feasible (as attested by the results from research question 1). Nevertheless, further investigations (research questions 2, 3, 4, and 5) demonstrated that teachers’ levels of metalinguistic awareness vary significantly. These results echoed previous findings that demonstrated that preservice teachers are not language-knowledgeable enough to deal with myriad issues that involve language, both in relation to students who are native speakers of English and also concerning ELs (Kolln & Hancock, 2005; Nutta et al., 2012; Pappamihiell, 2007). Preservice teachers’ lack higher level metalinguistic awareness, as evidenced by their limited ability to explain grammar errors and use proper metalanguage while doing so.

The main implication of the present study lies in the recommendation that more can and should be done in order to ensure that preservice teachers are
receiving the appropriate amount of language-oriented preparation during their college years. The present study offers a confirmatory perspective to previous research findings which found that preservice teachers are not knowledgeable enough in relation to language. Previous studies also pointed out to this lack of preparation as a generator of feelings of inadequacy and anxiety in preservice teachers while foreseeing their future students’ language struggles. Nonetheless, the present study also demonstrates that improvement can be achieved in regard to MA teacher preparedness in relatively little amount of time, especially for recognition of grammatical items such as parts of speech and parts of sentence. However, the findings demonstrate that more time is needed to ensure better results for complex grammar analyses such as explanation of grammatical errors.

Committee: Kerry Purmensky (Chair), Joyce Nutta (Co-Chair), Keith Folse, M. H. Clark, and Florin Mihai

Graduated Fall 2015
The Effect of Allocated Assessment Time and Allocated Instructional Time on Student Achievement in Small, Medium, and Large School Districts in Florida

SAMUEL CRUPI
Educational Leadership EdD - Executive

To date, there is little current research which explores the effect of allocated assessment time and allocated instructional time as related to student achievement (Spanjers, Burns, & Wagner, 2008). Current educational reform has placed accountability and assessment at the forefront of public education (Hirsh, 2007; Jennings, 2012; Kallemeyn, 2009; NCLB, 2001; Supovitz, 2009). Research of time on task has demonstrated that there may be a positive correlation between the amount of time on task in learning activities and student achievement (Fredricks, McColskey, Meli, Mordica, Montrosse, & Mooney, 2011). There is current legislation to increase the time demands of assessment and the resulting decrease of allocated instructional time may result in lower levels of student achievement (Butler, 1926; 1936; Brophy, Rohrkemper, Rashid, & Goldwater, 1982; Carroll, 1963; Doppelt, Mehalik, Schunn, Silk, & Krysinski, 2008; Spanjers, Burns, & Wagner, 2008; Wyss, Dolenc, Kong, & Tai, 2013). The purpose of this study was to compare allocated assessment time to allocated instructional time in small, medium, and large school districts in Florida. A sample of 12 school districts was selected representing small, medium, and large school districts based on student enrollment from Florida Education Finance Plan (FEFP) data. Data related to State and school district mandated assessments were collected for each school district using school district testing calendars and State assessment calendars. These data were examined and the number of minutes spent on each assessment was calculated. The calculation was used to determine the amount of time spent on State and school district mandated assessment. Allocated instructional time was calculated using the difference in allocated time and allocated assessment time. In addition, data were analyzed to determine what, if any, relationship existed between allocated assessment time and school district size as well as student achievement. Time
lost to assessment preparation was also included in the determination of allocated assessment time.

Committee: Barbara Murray (Chair), Kenneth Murray, Gordon Baldwin, and Larry Holt

Graduated Summer 2015
A Fifty State Legislative Review of Charter School Funding, Governance and Accountability

TIONIS FORDHAM
Educational Leadership EdD - Executive

As waves of educational reform spread across the United States, charter schools continue to emerge as an alternative to the traditional public school. This study examined funding, governance, and accountability provisions of nationwide charter school legislation to ascertain similarities, differences, litigated challenges and funding issues throughout the United States of America. In order to study charter school legislation and litigation, all of the United States charter school legislation was collected along with American court cases related to charter schools and charter legislation. Legislation was reviewed to identify similarities and differences in funding, accountability and governance provisions throughout America. Court cases, involving charter schools and charter school legislation, were reviewed to identify the types of issues being litigated and the resulting legal decisions. These legislative and case law findings can inform legislators, policy makers and school districts as they review and develop current legislative policies.

Committee: Kenneth Murray (Chair), Barbara Murray, Walter Doherty, and Cynthia Hutchinson

Graduated Summer 2015
A Historical Analysis of the Evolution of the Administrative and Organizational Structure of the University of Central Florida As It Relates to Growth

BOYD LINDSLEY

Educational Leadership EdD - Executive

This was a qualitative historical study, which was recounted chronologically and organized around the terms of the four full-time presidents of the university. The review addressed the processes associated with the establishment and development of Florida Technological University beginning in 1963 through its name change to the University of Central Florida in 1979, concluding in 2013. The organization's mission, vision, and goals, how they evolved and the impact they had on the university were of particular interest. The study was focused on the administrative actions and organizational changes that took place within the university to assist faculty in teaching, research, and service as well as external conditions and events which impacted the university and shaped its development. The growth of the university, as well as the productivity of the faculty, were of interest in the study.

Committee: Barbara Murray (Chair), Walter Doherty, Kenneth Murray, and Charles Dziuban

Graduated Spring 2015
World Language Teachers’ Preparation, Beliefs, and Instruction in Central Florida

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VALERIE MANN-GROSSO
Educational Leadership EdD - Executive

The purpose of this study was to investigate: (1) the extent to which world instructors report using specific communicative instructional strategies; (2) the difference between instructional strategies used by ESL only instructors, versus instructors of ESL and foreign languages, or instructors of only foreign languages; (3) the relationship between instructors’ academic preparation and target language use in class; and (4) the relationship between instructors’ pedagogical beliefs about second language learning and their reported target language use in class. The World Language Communicative Instructional Strategies Survey was administered to world language instructors from three academic institutions. Upon sending two requests, 48 instructors returned usable instruments (55%). Descriptive statistics revealed extensive use of communicative instructional strategies, yet a difference in application of these strategies exists. A comparison of means revealed that assuring that students learn collaboratively in 85% to 100% in target language, integration of all four language skills, and assuring students’ independent target language practice were applied less than other strategies. ESL instructors reported a higher use of communicative instructional strategies than instructors of ESL and foreign languages, or foreign languages only. A comparison of means indicated the differences in communicative instructional strategies use are in integration of all four language skills and in assuring 85% to 100% in-target-language collaborative learning. Findings also revealed a discrepancy between the reported use of communicative instructional strategies and the academic preparation received in order to do so. This study provides implications for the preparation of world language instructors. Specifically, the findings focused on mastery of language taught, on specific instructional methodology courses, and the practicum experience.

Committee: Rosemarye Taylor (Chair), Gordon Baldwin, Walter Doherty, and Joyce Nutta

Graduated Summer 2015
The Effect of Pre-service Teaching on Student Achievement Using a Co-teaching Model at an Elementary School in a Large, Urban School District in Central Florida

WALTON MCHALE
Educational Leadership EdD - Executive

This study was focused on the effect of pre-service teaching utilizing a co-teaching model on student achievement at an elementary school in a large, urban school district in central Florida. The contribution of university student teachers (i.e., interns) to elementary school achievement was investigated. Specifically explored was the difference between student achievement scores in classes with interns who participated in a co-teaching model and interns in classes that did not employ any structured approach to intern teaching. The researcher compared seven classes that employed co-teaching, where the university intern teacher and master teacher remained in the class conducting instruction, to seven classes that had a more traditional approach to the intern teaching. The co-teaching intern model did not exert a significant effect, either positive or negative, on student achievement.

Also investigated was the effect of an intern, utilizing any model, on student achievement scores, when compared to similar classes without the presence of an intern. The study utilized 14 classes with interns and 13 classes without interns; each group had populations of approximately 285 students. The presence of an intern did not exert a significant effect, either positive or negative, on student achievement. However, the data indicated that the presence of an intern could positively influence mathematics scores.

Additionally, the impact of teacher quality and socio-economic status on student achievement in reading and mathematics were explored. The data revealed the value of the individual teacher significantly affected student success in reading and mathematics. In reading, socio-economic status also significantly affected student achievement.

Committee: Kenneth Murray (Chair), Barbara Murray, Walter Doherty, and Cynthia Hutchinson

Graduated Summer 2015
A Case Study of the Perceived Effectiveness of the Two-Semester, Job-Embedded Internship

STEPHANIE OSMOND
Education Leadership EdD - Executive

The purpose of the study was to examine the perceived effectiveness of the two-semester, job-embedded internship for the development of effective Science, Technology, Engineering, and Mathematics (STEM) teachers. Students who were enrolled in the Resident Teacher Professional Preparation Program (RTP³) were able to earn a Master’s in the Art of Teaching (MAT), which included a two-semester, job-embedded internship. This study was designed to analyze the perceived effectiveness of the two-semester, job-embedded internship model at one urban high school from not only the resident teachers’, but also designees and stakeholders of the RTP³.

Resident teachers participated in the two-semester, job-embedded internship with the support of school site based mentors, school district and school site coaches, and university intern coordinators. The resident teachers participated in all aspect of the teaching process, and were evaluated using the school site evaluation instrument. As part of their internship, the resident teachers were evaluated using the Internship Assessment Summary Sheet. The resident teachers were also asked to participate in Lesson Study.

Data were gathered through both qualitative and quantitative sources. To collect qualitative data, interviews were conducted with the resident teachers, school site designees, school district designees and university designees. Each respondent was asked 10 questions developed by the researcher and vetted by experts in the field. The questions were designed to gather perceptions of effectiveness in preparation of the resident teachers, as well as strengths and weaknesses of the model. Recommendations for future use of the two-semester, job-embedded internship model were also gathered. Quantitative data were collected and analyzed using the Internship Assessment Summary Sheet to assess the perception of the intern coordinators.

The findings were that the two-semester, job-embedded internship was overall perceived as an effective model in preparing STEM teachers. The model allowed resident teachers to be engaged in the teaching process from the beginning of the school year. The support that was given throughout
the internship was beneficial in helping resident teachers with teaching practice. It was recommended that using frequent and actionable feedback should be continued. The one weakness of the model was the need for more pedagogical preparation, especially in the area of classroom management.

Committee: Rosemarye Taylor (Chair), Gordon Baldwin, Mary Kennedy, and Bryan Zugelder

Graduated Summer 2015
A Study of the Impact of Brevard Public School’s Peer Coaching Model on Student Achievement Outcomes and Teacher Evaluation Results

DEBRA PACE
Educational Leadership EdD - Executive

The focus of this research was to evaluate the effectiveness of a sustained professional development initiative, Peer Coaching, on improving teacher performance and student achievement. Developed in a large school district on the east coast of central Florida, Brevard’s Peer Coaching Model (BPCM) was implemented during the summer following the 2011-2012 school year to support teachers and administrators with implementation of a new teacher evaluation system designed to promote continuous improvement in teaching and learning. Teams of highly effective teachers were chosen from each school to participate in nine days of training and follow-up over the course of the study, in order to encourage improvement in their own instructional practice and the practice of their peers through greater understanding of the evaluation framework and observation rubrics, enhanced collaboration, and peer observation and coaching.

Quantitative data were obtained from Brevard Public Schools Office of Testing and Accountability for professional practices evaluation scores and value-added results. Professional practices scores are determined by trained and certified school administrators, assigning up to three points across seven dimensions for a total possible of 21 points. The school district assigns all teachers a three-year aggregated VAM score, based on results from Florida’s standardized test for reading and mathematics, FCAT, and BPS teachers earn a teacher-aggregated VAM (TAV), a non-FCAT teacher-aggregated VAM (NFTAV), or a school-aggregated VAM (SAV) depending on their grade level and content area assignment. Results for teachers who participated in a minimum of six days of BPCM training, before, during, and after the training’s implementation were analyzed and compared with the results of teachers who did not participate in BPCM training. The sample consisted of 174 BPS teachers, BPCM participants, similar in demographics and years of experience to the comparison population of teachers, non-BPCM participants.
Findings indicated that BPCM participants demonstrated a significant increase in professional practices scores during and after the training, with the most significant growth occurring after year one. In addition, BPCM participants earned significantly higher professional practices scores compared to teachers in the non-BPCM population, before, during, and after the professional learning experience. Differences in value-added results, however, were not statistically significant. Although both professional practices scores and value-added scores improved for BPCM and non-BPCM teachers during and following the training, changes in student outcomes were not statistically significant. These findings replicated previous findings that demonstrated a positive impact on instructional practices following implementation of a peer coaching professional learning model but limited impact on student achievement.

Implications for practice and recommendations for future research were provided for Brevard Public Schools and other school districts considering development and implementation of high quality professional learning to promote improvements in teaching and learning. Professional development models represent a significant investment of resources requiring careful planning for effective program evaluation to ensure that the desired outcomes of changes in practice and increases in student achievement are recognized.

Committee: Barbara Murray (Chair), Kenneth Murray, Rosemarye Taylor, and Elizabeth Thedy

Graduated Spring 2015
The Perceived Effectiveness of Mixed Reality Experiences in a Master of Arts in Teaching (MAT) Program for Science, Technology, Engineering, and Mathematics Degreed Individuals

CHANA SPEIR
Educational Leadership EdD - Executive

The purpose of this study was to examine the perceived effectiveness of mixed reality experiences on resident teachers who successfully completed an undergraduate Science, Technology, Engineering, or Mathematics (STEM) degree and were enrolled in a Master of Arts in Teaching (MAT) degree program as part of RTP at a large research university in Orlando, Florida. The population for this study consisted of those selected to be in the RTP, which included being in the Masters in the Art of Teaching (MAT) and becoming a middle or high school science, mathematics, or engineering teacher.

The resident teachers experienced mixed reality as a method of practice on two occasions. The first was to introduce a lesson with avatar middle school students and a second time to conduct a parent conference with an avatar parent. This study was focused on the resident teachers’ perceptions of (a) the effectiveness of mixed reality in the lesson experience and parent conference, (b) the coach’s helpfulness after the lesson introduction experience and the parent conference experience, and (c) the extent to which the resident teachers believe that their confidence was increased and they were prepared for future classroom instruction and parent interactions through the use of mixed reality.

Data were gathered with a feedback form with Likert-type items and open ended items completed immediately upon completion of each experience, as well as an additional open response document completed at a later time after reflection on the entire experience. The researcher analyzed the two qualitative data sources independently to determine trends and themes.

Findings in this study were that the mixed-reality laboratory experience did have a positive effect on the perceptions of the resident teachers regarding their level of preparedness. They were more confident and comfortable.
teaching a lesson and conducting a parent conference after practicing both experiences with the avatars. Resident teachers overwhelmingly responded that the mixed reality experiences should remain a part of the MAT pedagogy and that they gained insight and confidence through the mixed reality practice.

Committee: Rosemarye Taylor (Chair), Gordon Baldwin, Walter Doherty, and Paul Mitchell

Graduated Spring 2015
The Education Pathway Through Social and Economic Integration of Highly Educated Immigrants: The Case of Colombians in the United States

OLGA BEDOYA ARTURO
Educational Leadership EdD - Higher Education

Developed countries have promoted immigration of educated people as a strategy to satisfy the demand for educated labor. Highly educated immigrants' poor language skills, absence of cultural networks, and lack of credentials and recognized professional experience gained in the country of origin are barriers to their social and economic integration (Ferrer & Riddell, 2008; Mattoo, Neagu, & Özden, 2008; Miranda & Umhoefer, 1998; Zikic, Bonache, & Cerdin, 2010). The purpose of this study was to explore how college experiences in an American college or university facilitate or hinder the transfer and gain of different forms of capital among highly educated Colombia immigrants. All of the participants in this study completed at least a bachelor's degree before moving to the United States and came to this country under any visa category except that of student. Two in-depth interviews were conducted with six Colombian immigrants living in the state of Florida. The results of the study revealed five common themes shared by the participants: (1) exposure and exchange of different forms of thinking and cultural expressions; (2) performing in ways that meet requirements of American institutions; (3) achieving credentials recognized by professionals in the United States' job market and social structure; (4) capacity to assess their own abilities and take control of their future; and (5) connections that provide social, emotional, and intellectual support as well as information.

Committee: Rosa Cintron Delgado (Chair), J. Owens, Gloria Laureano Fuente, and Fernando Rivera

Graduated Fall 2015
Institutionalizing Service-Learning as a Best Practice of Community Engagement in Higher Education: Intra- and Inter-Institutional Comparisons of the Carnegie Community Engagement Elective Classification Framework

JARRAD PLANTE
Educational Leadership EdD - Higher Education

Service-learning, with a longstanding history in American higher education (Burkhardt & Pasque, 2005), includes three key tenets: superior academic learning, meaningful and relevant community service, and persistent civic learning (McGoldrick and Ziegert, 2002). The Carnegie Foundation for the Advancement of Teaching has created an elective classification system—Carnegie Community Engagement Classification—for institutions of higher education to demonstrate the breadth and depth of student involvement and learning through partnerships and engagement in the community (Dalton & Crosby, 2011; Hurtado & DeAngelo, 2012; Kuh et al., 2008; Pryor, Hurtado, Saenz, Santos, & Korn, 2007). Community engagement “is in the culture, commonly understood practices and knowledge, and (CCEC helps determine) whether it is really happening—rhetoric versus reality” (J. Saltmarsh, personal communication, August 11, 2014). The study considers the applications of three Carnegie Community Engagement Classification designated institutions to understand the institutionalization of service-learning over time by examining the 2008 designation and 2015 reclassification across institution types—a Private Liberal Arts College, a Private Teaching University, and a Public Research University located in the same metropolitan area. Organizational Change Theory was used as a theoretical model. Case study methodology was used in the present qualitative research to perform document analysis with qualitative interviews conducted to elucidate the data from the 2008 and 2015 CCEC applications from the three institutions. Using intra- and inter-comparative analysis, this study highlights approaches, policies, ethos, and emerging concepts to inform how higher education institutions increase the quality and quantity
of service-learning opportunities that benefit higher education practitioners as well as community leaders.

Committee: Thomas Cox (Chair), Sandra Robinson (Co-Chair), Thomas Bryer, and Melody Bowdon

Graduated Summer 2015
African American Head Football Coaches at Division I FBS Schools: A Qualitative Study on Turning Points

THADDEUS RIVERS
Educational Leadership EdD - Higher Education

This dissertation was centered on how the theory ‘turning points’ explained African American coaches ascension to Head Football Coach at a NCAA Division I FBS school. This work (1) identified traits and characteristics coaches felt they needed in order to become a head coach and (2) described the significant events and people (turning points) in their lives that have influenced their career.

This study employed a Constant Comparative method in which participants answered interview questions designed for them to elaborate on their educational and athletic careers, and those events and people who were major influences in their careers. Commonalities and discords from participant responses resulted in the discovery of five major themes. The themes identified were: Faith, Family, Graduation from college and participation in sport, Joining professional associations, and Previous coaches/administrators worked for/under.

The identification and explanation of specific turning points suggest a blueprint for African American assistant coaches aspiring to become a head coach while also providing opportunities for current athletic administrators to increase their attempts at expanding their own networks to include more African Americans as strong candidates for potential open positions for Head Football Coach.

Committee: Rosa Cintron Delgado (Chair), J. Owens, Jeff Duke, and Carlton Harrison

Graduated Fall 2015
An Analysis of Faculty Collaboration on Student Transfer through Articulation Agreements

NICHOLE SHORTER
Educational Leadership EdD - Higher Education

This dissertation explored the ways faculty at two- and four-year institutions with articulation agreements collaborate to improve the retention rates of transfer students, using the Wilder Collaboration Factors (WCF) as a theoretical lens. This research was conducted to analyze the level of collaboration, and differentiate among the perceptions of collaboration among university and community college faculty. The purpose of the study was to build upon the limited amount of research on postsecondary collaboration. Nonparametric statistical analyses were performed to provide answers to the research questions.

Analysis of the data revealed that the participants demonstrated strength in 18 of the 20 WCF. The analysis also indicated that there was no statistically significant difference between the perceptions of collaboration among university and community college faculty. A principal components analysis led to the development of a modified conceptual framework joining the WCF and stages of collaboration that may be used to inform practice and policy. Recommendations include allocating faculty release time or incentives for collaboration, expanding articulation agreements to include K-12 alignment and policies on faculty collaboration, and using the Wilder Collaboration Factors Inventory (WCFI) as a tool to continue to assess the strengths, weaknesses, and differences in perception among university and community college faculty as they advance in collaborative stages.

Committee: Rosa Cintron Delgado (Chair), J. Owens, Michael Preston, and Janet Andreasen

Graduated Fall 2015
College of ENGINEERING AND COMPUTER SCIENCE
Within the architecture, engineering, and construction (AEC) domain, simulation modeling is mainly used to facilitate decision-making by enabling the assessment of different operational plans and resource arrangements, that are otherwise difficult (if not impossible), expensive, or time consuming to be evaluated in real world settings. The accuracy of such models directly affects their reliability to serve as a basis for important decisions such as project completion time estimation and resource allocation. Compared to other industries, this is particularly important in construction and infrastructure projects due to the high resource costs and the societal impacts of these projects. Discrete event simulation (DES) is a decision making tool that can benefit the process of design, control, and management of construction operations. Despite recent advancements, most DES models used in construction are created during the early planning and design stage when the lack of factual information from the project prohibits the use of realistic data in simulation modeling. The resulting models, therefore, are often built using rigid (subjective) assumptions and design parameters (e.g. precedence logic, activity durations). In all such cases and in the absence of an inclusive methodology to incorporate real field data as the project evolves, modelers rely on information from previous projects (a.k.a. secondary data), expert judgments, and subjective assumptions to generate simulations to predict future performance. These and similar shortcomings have to a large extent limited the use of traditional DES tools to preliminary studies and long-term planning of construction projects.

In the realm of the business process management, process mining as a relatively new research domain seeks to automatically discover a process model by observing activity records and extracting information about processes. The research presented in this Ph.D. Dissertation was in part inspired by the prospect of construction process mining using sensory data collected from field agents. This enabled the extraction of operational knowledge necessary to generate and maintain the fidelity of simulation models. A preliminary study was conducted to demonstrate the feasibility
and applicability of data-driven knowledge-based simulation modeling with focus on data collection using wireless sensor network (WSN) and rule-based taxonomy of activities. The resulting knowledge-based simulation models performed very well in properly predicting key performance measures of real construction systems. Next, a pervasive mobile data collection and mining technique was adopted and an activity recognition framework for construction equipment and worker tasks was developed. Data was collected using smartphone accelerometers and gyroscopes from construction entities to generate significant statistical time- and frequency-domain features. The extracted features served as the input of different types of machine learning algorithms that were applied to various construction activities. The trained predictive algorithms were then used to extract activity durations and calculate probability distributions to be fused into corresponding DES models. Results indicated that the generated data-driven knowledge-based simulation models outperform static models created based upon engineering assumptions and estimations with regard to compatibility of performance measure outputs to reality.

Committee: Amir Behzadan (Chair), Amr Oloufa, Hae-Bum Yun, Gita Sukthankar, and Qipeng Zheng

Graduated Spring 2015
A New Methodology for Evaluating the Effectiveness of Bus Rapid Transit Strategies

AHMAD ALOMARI

Civil Engineering PhD

Over the last few years, public transportation has become more desirable as capacity of existing roadways failed to keep up with rapidly increasing traffic demand. Buses are one of the most common modes of public transportation with low impact on network capacity, especially in small and congested urban areas. However, the use of regularly scheduled buses as the main public transport mode can become useless with the presence of traffic congestion and dense construction areas. In cases like these, innovative solutions, such as bus rapid transit (BRT), can provide an increased level of service without having to resort to other, more expensive modes, such as light rail transit (LRT) and metro systems (subways). Transit signal priority (TSP), which provides priority to approaching buses at signalized intersections by extending the green or truncating the red, can also increase the performance of the bus service.

Understanding the combined impact of TSP and BRT on network traffic operations can be complex. Although TSP has been implemented worldwide, none of the previous studies have examined in depth the effects of using conditional and unconditional TSP strategies with a BRT system. The objective of this research is to evaluate the effectiveness of BRT without TSP, then with conditional or unconditional TSP strategies. The micro-simulation software VISSIM was used to compare different TSP and BRT scenarios. These simulation scenarios include the base scenario (before implementation of the TSP and BRT systems), Unconditional TSP (TSP activates for all buses), Conditional TSP 3 minutes behind (TSP only activates for buses that are 3 minutes or more behind schedule), Conditional TSP 5 minutes behind (only activates for buses 5 minutes or more behind schedule), BRT with no TSP, BRT with Unconditional TSP, BRT with Conditional TSP 3 minutes behind, and BRT with Conditional TSP 5 minutes behind.

The VISSIM simulation model was developed, calibrated and validated using a variety of data that was collected in the field. These data included geometric data, (number of lanes, intersection geometries, etc.); traffic data
(average daily traffic volumes at major intersections, turning movement percentages at intersections, heavy vehicle percentages, bus passenger data, etc.); and traffic control data (signal types, timings and phasings, split history, etc.). Using this field data ensured the simulation model was sufficient for modeling the test corridor. From this model, the main performance parameters (for all vehicles and for buses only) for through movements in both directions (eastbound and westbound) along the corridor were analyzed for the various BRT/TSP scenarios. These parameters included average travel times, average speed profiles, average delays, and average number of stops. As part of a holistic approach, the effects of BRT and TSP on crossing street delay were also evaluated.

Simulation results showed that TSP and BRT scenarios were effective in reducing travel times (up to 26%) and delays (up to 64%), as well as increasing the speed (up to 47%), compared to the base scenario. The most effective scenarios were achieved by combining BRT and TSP. Results also showed that BRT with Conditional TSP 3 minutes behind significantly improved travel times (17 – 26%), average speed (30 – 39%), and average total delay per vehicle (11 – 32%) for the main corridor through movements compared with the base scenario, with only minor effects on crossing street delays. BRT with Unconditional TSP resulted in significant crossing street delays, especially at major intersections with high traffic demand, which indicates that this scenario is impractical for implementation in the corridor. Additionally, BRT with Conditional TSP 3 minutes behind had better travel time savings than BRT with Conditional TSP 5 minutes behind for both travel directions, making this the most beneficial scenario.

This research provided an innovative approach by using nested sets (hierarchical design) of TSP and BRT combination scenarios. Coupled with microscopic simulation, nested sets in the hierarchical design are used to evaluate the effectiveness of BRT without TSP, then with conditional or unconditional TSP strategies. The robust methodology developed in this research can be applied to any corridor to understand the combined TSP and BRT effects on traffic performance. Presenting the results in an organized fashion like this can be helpful in decision making.

This research investigated the effects of BRT along I-Drive corridor (before and after conditions) at the intersection level. Intersection analysis demonstrated based on real life data for the before and after the construction of BRT using the Highway Capacity Software™ (HCS2010) that was
built based on the Highway Capacity Manual (HCM 2010) procedures for urban streets and signalized intersections. The performance measure used in this analysis is the level of service (LOS) criteria which depends on the control delay (seconds per vehicle) for each approach and for the entire intersection. The results show that implementing BRT did not change the LOS. However, the control delay has improved at most of the intersections’ approaches. The majority of intersections operated with an overall LOS “C” or better except for Kirkman Road intersection (T2) with LOS “E” because it has the highest traffic volumes before and after BRT construction.

This research also used regression analysis to observe the effect of the tested scenarios analyzed in VISSIM software compared to the No TSP – No BRT base model for all vehicles and for buses only. The developed regression model can predict the effect of each scenario on each studied Measures of Performance (MOE). Minitab statistical software was used to conduct this multiple regression analysis. The developed models with real life data input are able to predict how proposed enhancements change the studied MOEs. The BRT models presented in this research can be used for further sensitivity analysis on a larger regional network in the upcoming regional expansion of the transit system in Central Florida. Since this research demonstrated the operational functionality and effectiveness of BRT and TSP systems in this critical corridor in Central Florida, these systems’ accomplishments can be expanded throughout the state of Florida to provide greater benefits to transit passengers. Furthermore, to demonstrate the methodology developed in this research, it is applied to a test corridor along International Drive (I-Drive) in Orlando, Florida. This corridor is key for regional economic prosperity of Central Florida and the novel approach developed in this dissertation can be expanded to other transit systems.

Committee: Haitham Al-Deek (Chair), Naveen Eluru, Omer Tatari, and Edgard Maboudou

Graduated Fall 2015
Construction of municipal utility complexes has to support continuing population growth, economic development, and a widespread of social interest in environmental preservation. Municipalities face challenges in designing, constructing, and operating environmentally sustainable utility complexes, and their primary goal in developing such a complex is to minimize the environmental impact resulting from energy production and waste treatment (both liquid and solid), management, and disposal. However, decision and policy makers lack a system of systems approach that takes into account multiple interdependent systems comprised of the functional system (infrastructure, facilities, operations within the complex...), the economic system, the social/cultural system, and the environmental system (environmental impact on air, water, soil...). This research proposes a decision support system (DSS) with a new methodology using Vensim software and system dynamics methodology to assess the sustainability of a municipal utility complex system. This DSS incorporates 1) multiple interdependent systems, 2) multiple sustainability/performance indices, and 3) composite sustainability index. Engineers, managers, and researchers should benefit from a system of systems perspective, and from the application of a sustainability assessment method that is developed to provide an environmentally-conscious design, construction and management. Although a municipal utility complex is built with synergistic opportunities for integration of processes of a wastewater treatment plant, a resource recovery facility (aka waste-to-energy (WTE) or incineration facility), a material recycling facility (MRF), and a landfill; engineers tend to use the traditional sustainability assessment methods only to assess the life cycle (LCA) of each system’s process over time. They might not necessarily incorporate an assessment based on system dynamics of the functional, economic, environmental, and social/cultural systems. Data from a case study is utilized
in this dissertation based on the municipal utility complex in Pasco County in the western region of the State of Florida, USA.

Committee: Amr Oloufa (Chair), Omer Tatari (Co-Chair), Haitham Al-Deek, and John Kincaid

Graduated Fall 2015
Analytical Study of Computer Vision-based Pavement Crack Quantification Using Machine Learning Techniques

SOROUSH MOKHTARI
Civil Engineering PhD

Image-based techniques are a promising non-destructive approach for road pavement condition evaluation. The main objective of this study is to extract, quantify and evaluate important surface defects, such as cracks, using an automated computer vision-based system to provide a better understanding of the pavement deterioration process. To achieve this objective, an automated crack-recognition software was developed, employing a series of image processing algorithms of crack extraction, crack grouping, and crack detection. Bottom-hat morphological technique was used to remove the random background of pavement images and extract cracks, selectively based on their shapes, sizes, and intensities using a relatively small number of user-defined parameters. A technical challenge with crack extraction algorithms, including the Bottom-hat transform, is that extracted crack pixels are usually fragmented along crack paths. For de-fragmenting those crack pixels, a novel crack-grouping algorithm is proposed as an image segmentation method, so called MorphLink-C. Statistical validation of this method using flexible pavement images indicated that MorphLink-C not only improves crack-detection accuracy but also reduces crack detection time.

Crack characterization was performed by analysing imagerial features of the extracted crack image components. A comprehensive statistical analysis was conducted using filter feature subset selection (FSS) methods, including Fischer score, Gini index, information gain, ReliefF, mRmR, and FCBF to understand the statistical characteristics of cracks in different deterioration stages. Statistical significance of crack features was ranked based on their relevancy and redundancy. The statistical method used in this study can be employed to avoid subjective crack rating based on human visual inspection. Moreover, the statistical information can be used as fundamental data to justify rehabilitation policies in pavement maintenance.

Finally, the application of four classification algorithms, including Artificial Neural Network (ANN), Decision Tree (DT), k-Nearest Neighbours (kNN) and Adaptive Neuro-Fuzzy Inference System (ANFIS) is investigated for
the crack detection framework. The classifiers were evaluated in the following five criteria: 1) prediction performance, 2) computation time, 3) stability of results for highly imbalanced datasets in which, the number of crack objects are significantly smaller than the number of non-crack objects, 4) stability of the classifiers performance for pavements in different deterioration stages, and 5) interpretability of results and clarity of the procedure. Comparison results indicate the advantages of white-box classification methods for computer vision based pavement evaluation. Although black-box methods, such as ANN provide superior classification performance, white-box methods, such as ANFIS, provide useful information about the logic of classification and the effect of feature values on detection results. Such information can provide further insight for the image-based pavement crack detection application.

Committee: Hae-Bum Yun (Chair), Boo Hyun Nam (Vice Chair), Necati Catbas, Mubarak Shah, and Petros Xanthopoulos

Graduated Spring 2015
Integrated Sustainability Assessment Framework for the U.S. Transportation

NURI ONAT
Civil Engineering PhD

This dissertation aims to investigate the sustainability impacts of alternative vehicle technologies and develop comprehensive sustainability assessment frameworks to analyze potential impacts of these vehicles in the U.S. In order to assess sustainability impact of vehicle alternatives, life-cycle based models has been extensively used in the literature. Although life cycle-based models are often used for environmental impacts of alternative vehicles, analysis of social and economic impacts of these vehicles has gained a tremendous interest. In this regard, there is a growing interest among the international platform and academia to use the Life Cycle Sustainability Assessment framework to have more informed sustainable products, material and technology choices by considering the environmental, as well as social and economic impacts. The Life Cycle Sustainability Assessment framework is still under development and there is an ongoing research to advance it for future applications. In this dissertation, current and future needs of sustainability assessment frameworks and the U.S. transportation are identified and addressed. The major research gaps are identified as follows: (1) there has been small emphasis on effects of spatial and temporal variations on the sustainability impacts of alternative vehicle technologies, (2) no national research efforts as of now have been directed specifically toward understanding the fundamental relationship between the adoption of electric vehicles and water demand, (3) there has been a lack of understanding the dynamic complexity of transportation sustainability, encompassing feedback mechanisms, and interdependencies, for the environmental, social, and economic impacts of alternative vehicles, and (4) there is no emphasis on addressing uncertainties inherent to the U.S. transportation and its complex relationships with the environment, society, and economy.

The environmental, economic, and social impacts of alternative vehicles are highly critical for truly assessing and understanding the long-term sustainability of vehicles and propose economically viable, socially acceptable, and environment-friendly transportation solutions for U.S. passenger transportation. This dissertation provides a more comprehensive
sustainability assessment framework by realizing following objectives: (1) inclusion of spatial and temporal variations when quantifying carbon, energy, and water footprints of alternative vehicle technologies, (2) quantifying environmental, social, and economic impacts of alternative vehicle technologies, (3) capturing the dynamic relations among the parameters of U.S. transportation system, environment, society, and the economy, (4) dealing with uncertainties inherent to the U.S. transportation sector considering the complexity of the system and dynamic relationships.

The results of this dissertation reveal that the results with consideration of uncertainties, temporal and spatial variations, and dynamic complex relationships among the system variables can be significantly different than those of without consideration of those. Therefore, when developing policies the robustness of proposed scenarios should be valued with consideration of uncertainties, temporal and spatial variations as well as the dynamic feedback mechanisms. The outcomes of this study can pave the way for advancement in the state-of-the-art and state-of-the-practice in the sustainability research by presenting novel approaches to deal with uncertainties and complex systems.

Committee: Mehmet Tatari (Chair), Boo Hyun Nam, Amr Oloufa, and Jennifer Pazour

Graduated Summer 2015
Traffic safety is a major concern for the public, and it is an important component of the roadway management strategy. In order to improve highway safety, extensive efforts have been made by researchers, transportation engineers, Federal, State, and local government officials. With these consistent efforts, both fatality and injury rates from road traffic crashes in the United States have been steadily declining over the last six years (2006-2011). However, according to the National Highway Traffic Safety Administration (NHTSA, 2013), 33,561 people died in motor vehicle traffic crashes in the United States in 2012, compared to 32,479 in 2011, and it is the first increase in fatalities since 2005. Moreover, in 2012, an estimated 2.36 million people were injured in motor vehicle traffic crashes, compared to 2.22 million in 2011.

Due to the demand of highway safety improvements through systematic analysis of specific roadway cross-section elements and treatments, the Highway Safety Manual (HSM) (AASHTO, 2010) was developed by the Transportation Research Board (TRB) to introduce a science-based technical approach for safety analysis. One of the main parts in the HSM, Part D, contains crash modification factors (CMFs) for various treatments on roadway segments and at intersections. A CMF is a factor that can estimate potential changes in crash frequency as a result of implementing a specific treatment (or countermeasure). CMFs in Part D have been developed using high-quality observational before-after studies that account for the regression to the mean threat. Observational before-after studies are the most common methods for evaluating safety effectiveness and calculating CMFs of specific roadway treatments. Moreover, cross-sectional method has commonly been used to derive CMFs since it is easier to collect the data compared to before-after methods.

Although various CMFs have been calculated and introduced in the HSM, still there are critical limitations that are required to be investigated. First, the HSM provides various CMFs for single treatments, but not CMFs for
multiple treatments to roadway segments. The HSM suggests that CMFs are multiplied to estimate the combined safety effects of single treatments. However, the HSM cautions that the multiplication of the CMFs may over- or under-estimate combined effects of multiple treatments. In this dissertation, several methodologies are proposed to estimate more reliable combined safety effects in both observational before-after studies and the cross-sectional method. Averaging two best combining methods is suggested to use to account for the effects of over- or under-estimation. Moreover, it is recommended to develop adjustment factor and function (i.e. weighting factor and function) to apply to estimate more accurate safety performance in assessing safety effects of multiple treatments. The multivariate adaptive regression splines (MARS) modeling is proposed to avoid the over-estimation problem through consideration of interaction impacts between variables in this dissertation.

Second, the variation of CMFs with different roadway characteristics among treated sites over time is ignored because the CMF is a fixed value that represents the overall safety effect of the treatment for all treated sites for specific time periods. Recently, few studies developed crash modification functions (CMFunctions) to overcome this limitation. However, although previous studies assessed the effect of a specific single variable such as AADT on the CMFs, there is a lack of prior studies on the variation in the safety effects of treated sites with different multiple roadway characteristics over time. In this study, adopting various multivariate linear and nonlinear modeling techniques is suggested to develop CMFunctions. Multiple linear regression modeling can be utilized to consider different multiple roadway characteristics. To reflect nonlinearity of predictors, a regression model with nonlinearizing link function needs to be developed. The Bayesian approach can also be adopted due to its strength to avoid the problem of over fitting that occurs when the number of observations is limited and the number of variables is large. Moreover, two data mining techniques (i.e. gradient boosting and MARS) are suggested to use 1) to achieve better performance of CMFunctions with consideration of variable importance, and 2) to reflect both nonlinear trend of predictors and interaction impacts between variables at the same time.

Third, the nonlinearity of variables in the cross-sectional method is not discussed in the HSM. Generally, the cross-sectional method is also known as safety performance functions (SPFs) and generalized linear model (GLM) is applied to estimate SPFs. However, the estimated CMFs from
GLM cannot account for the nonlinear effect of the treatment since the coefficients in the GLM are assumed to be fixed. In this dissertation, applications of using generalized nonlinear model (GNM) and MARS in the cross-sectional method are proposed. In GNM s, the nonlinear effects of independent variables to crash analysis can be captured by the development of nonlinearizing link function. Moreover, the MARS accommodate nonlinearity of independent variables and interaction effects for complex data structures.

In this dissertation, the CMFs and CMFunctions are estimated for various single and combination of treatments for different roadway types (e.g. rural two-lane, rural multi-lane roadways, urban arterials, freeways, etc.) as below:

• **Treatments for mainline of roadway:**
  - adding a thru lane, conversion of 4-lane undivided roadways to 3-lane with two-way left turn lane (TWLTL)

• **Treatments for roadway shoulder:**
  - installing shoulder rumble strips, widening shoulder width, adding bike lanes, changing bike lane width, installing roadside barriers

• **Treatments related to roadside features:**
  - decrease density of driveways, decrease density of roadside poles, increase distance to roadside poles, increase distance to trees

Expected contributions of this study are to 1) suggest approaches to estimate more reliable safety effects of multiple treatments, 2) propose methodologies to develop CMFunctions to assess the variation of CMFs with different characteristics among treated sites, and 3) recommend applications of using GNM and MARS to simultaneously consider the interaction impact of more than one variables and nonlinearity of predictors.

Finally, potential relevant applications beyond the scope of this research but worth investigation in the future are discussed in this dissertation.

Committee: Mohamed Abdel-Aty (Chair), Essam Radwan, Naveen Eluru, Chung-Ching Wang, and JaeYoung Lee

*Graduated Summer 2015*
Sea level rise (SLR) has the potential to affect coastal environments in a multitude of ways, including submergence, increased flooding, and increased shoreline erosion. Low-lying coastal environments such as the Northern Gulf of Mexico (NGOM) are particularly vulnerable to the effects of SLR, which may have serious consequences for coastal communities as well as ecologically and economically significant estuaries. Evaluating potential changes in tidal hydrodynamics under SLR is essential for understanding impacts to navigation, ecological habitats, infrastructure and the morphologic evolution of the coastline. The intent of this research is to evaluate the dynamic effects of SLR and coastal geomorphology on tidal hydrodynamics along the NGOM and within three National Estuarine Research Reserves (NERRs), namely Grand Bay, MS, Weeks Bay, AL, and Apalachicola, FL.

An extensive literature review examined the integrated dynamic effects of SLR on low gradient coastal landscapes, primarily in the context of hydrodynamics, coastal morphology, and marsh ecology. Despite knowledge of the dynamic nature of coastal systems, many studies have neglected to consider the nonlinear effects of SLR and employed a simplistic “bathtub” approach in SLR assessments. More recent efforts have begun to consider the dynamic effects of SLR (e.g., the nonlinear response of hydrodynamics under SLR); however, little research has considered the integrated feedback mechanisms and co-evolution of multiple interdependent systems (e.g., the nonlinear responses and interactions of hydrodynamics and coastal morphology under SLR). Synergetic approaches that integrate the dynamic interactions between physical and ecological environments will allow for more comprehensive evaluations of the impacts of SLR on coastal systems.

Projecting future morphology is a challenging task; various conceptual models and statistical methods have been employed to project future shoreline positions. Projected shoreline change rates from a conceptual model were compared with historic shoreline change rates from two databases along sandy shorelines of the South Atlantic Bight and NGOM.
coasts. The intent was not to regard one method as superior to another, but rather to explore similarities and differences between the methods and offer suggestions for projecting shoreline changes in SLR assessments.

The influence of incorporating future shoreline changes into hydrodynamic modeling assessments of SLR was evaluated for the NGOM coast. Astronomic tides and hurricane storm surge were simulated under present conditions, the projected 2050 sea level with present-day shorelines, and the projected 2050 sea level with projected 2050 shorelines. Results demonstrated that incorporating shoreline changes had variable impacts on the hydrodynamics; storm surge was more sensitive to the shoreline changes than astronomic tides. It was concluded that estimates of shoreline change should be included in hydrodynamic assessments of SLR along the NGOM.

Evaluating how hydrodynamics have been altered historically under a changing landscape in conjunction with SLR can provide insight to future changes. The Grand Bay estuary has undergone significant landscape changes historically. Tidal hydrodynamics were simulated for present and historic conditions (dating back to 1848) using a hydrodynamic model modified with unique sea levels, bathymetry, topography, and shorelines representative of each time period. Changes in tidal amplitudes varied across the domain. Harmonic constituent phases sped up from historic conditions. Tidal velocities in the estuary were stronger historically, and reversed from being flood dominant in 1848 to ebb dominant in 2005.

To project how tidal hydrodynamics may be altered under future scenarios along the NGOM and within the three NERRs, a hydrodynamic model was used to simulate present (circa 2005) and future (circa 2050 and 2100) astronomic tides. The model was modified with projections of future sea levels as well as shoreline positions and dune elevations obtained from a Bayesian network (BN) model. Tidal amplitudes within some of the embayments increased under the higher SLR scenarios; there was a high correlation between the change in the inlet cross-sectional area under SLR and the change in the tidal amplitude within each bay. Changes in harmonic constituent phases indicated faster tidal propagation in the future scenarios within most of the bays. Tidal velocities increased in all of the NERRs which altered flood and ebb current strengths.

The work presented herein improves the understanding of the response of tidal hydrodynamics to morphology and SLR. This is beneficial not only to
the scientific community, but also to the management and policy community. These findings will have synergistic effects with a variety of coastal studies including storm surge and biological assessments of SLR. In addition, findings can benefit monitoring and restoration activities in the NERRs. Ultimately, outcomes will allow coastal managers and policy makers to make more informed decisions that address specific needs and vulnerabilities of each particular estuary, the NGOM coastal system, and estuaries elsewhere with similar conditions.

Committee: Scott Hagen (Chair), Stephen Medeiros, Dingbao Wang, and John Weishampel

Graduated Spring 2015
Applications of Computer Vision Technologies of Automated Crack Detection and Quantification for the Inspection of Civil Infrastructure Systems

LIULIU WU
Civil Engineering PhD

Many components of existing civil infrastructure systems, such as road pavement, bridges, and buildings, are suffered from rapid aging, which require enormous nation’s resources from federal and state agencies to inspect and maintain them. Crack is one of important material and structural defects, which must be inspected not only for good maintenance of civil infrastructure with a high quality of safety and serviceability, but also for the opportunity to provide early warning against failure. Conventional human visual inspection is still considered as the primary inspection method. However, it is well established that human visual inspection is subjective and often inaccurate. In order to improve current manual visual inspection for crack detection and evaluation of civil infrastructure, this study explores the application of computer vision techniques as a non-destructive evaluation and testing (NDE&T) method for automated crack detection and quantification for different civil infrastructures.

In this study, computer vision-based algorithms were developed and evaluated to deal with different situations of field inspection that inspectors could face with in crack detection and quantification. The depth, the distance between camera and object, is a necessary extrinsic parameter that has to be measured to quantify crack size since other parameters, such as focal length, resolution, and camera sensor size are intrinsic, which are usually known by camera manufacturers. Thus, computer vision techniques were evaluated with different crack inspection applications with constant and variable depths. For the fixed-depth applications, computer vision techniques were applied to two field studies, including 1) automated crack detection and quantification for road pavement using the Laser Road Imaging System (LRIS), and 2) automated crack detection on bridge cables surfaces, using a cable inspection robot. For the various-depth applications, two field studies were conducted, including 3) automated crack recognition and width measurement of concrete bridges’ cracks using a high-magnification telescopic lens, and
4) automated crack quantification and depth estimation using wearable glasses with stereovision cameras.

From the realistic field applications of computer vision techniques, a novel self-adaptive image-processing algorithm was developed using a series of morphological transformations to connect fragmented crack pixels in digital images. The crack-defragmentation algorithm was evaluated with road pavement images. The results showed that the accuracy of automated crack detection, associated with artificial neural network classifier, was significantly improved by reducing both false positive and false negative. Using up to six crack features, including area, length, orientation, texture, intensity, and wheel-path location, crack detection accuracy was evaluated to find the optimal sets of crack features. Lab and field test results of different inspection applications show that proposed computer vision-based crack detection and quantification algorithms can detect and quantify cracks from different structures’ surface and depth. Some guidelines of applying computer vision techniques are also suggested for each crack inspection application.

Committee: Hae-Bum Yun (Chair), Boo Hyun Nam, Necati Catbas, and Hassan Foroosh

Graduated Spring 2015
Quantifying Trust and Reputation for Defense against Adversaries in Multi-Channel Dynamic Spectrum Access Networks

SHAMEEK BHATTACHARJEE
Computer Engineering PhD

Dynamic spectrum access enabled by cognitive radio networks are envisioned to drive the next generation wireless networks that can increase spectrum utility by opportunistically accessing unused spectrum. Due to the policy constraint that there could be no interference to the primary (licensed) users, secondary cognitive radios have to continuously sense for primary transmissions. Typically, sensing reports from multiple cognitive radios are fused as stand-alone observations are prone to errors due to wireless channel characteristics. Such dependence on cooperative spectrum sensing is vulnerable to attacks such as Secondary Spectrum Data Falsification (SSDF) attacks when multiple malicious or selfish radios falsify the spectrum reports. Hence, there is a need to quantify the trustworthiness of radios that share spectrum sensing reports and devise malicious node identification and robust fusion schemes that would lead to correct inference about spectrum usage.

In this work, we propose an anomaly monitoring technique that can effectively capture anomalies in the spectrum sensing reports shared by individual cognitive radios during cooperative spectrum sensing in a multi-channel distributed network. Such anomalies are used as evidence to compute the trustworthiness of a radio by its neighbours. The proposed anomaly monitoring technique works for any density of malicious nodes and for any physical environment. We propose an optimistic trust heuristic for a system with a normal risk attitude and show that it can be approximated as a beta distribution. For a more conservative system, we propose a multinomial Dirichlet distribution based conservative trust framework, where Josang’s Belief model is used to resolve any uncertainty in information that might arise during anomaly monitoring. Using a machine learning approach, we identify malicious nodes with a high degree of certainty regardless of their aggressiveness and variations introduced by the pathloss environment. We also propose extensions to the anomaly monitoring technique that facilitate learning about strategies employed by malicious nodes and also utilize the misleading information they provide.
We also devise strategies to defend against a collaborative SSDF attack that is launched by a coalition of selfish nodes. Since defense against such collaborative attacks is difficult with popularly used voting based inference models or node centric isolation techniques, we propose a channel centric Bayesian inference approach that indicates how much the collective decision on a channel’s occupancy inference can be trusted. Based on the measured observations over time, we estimate the parameters of the hypothesis of anomalous and non-anomalous events using a multinominal Bayesian based inference. We quantitatively define the trustworthiness of a channel inference as the difference between the posterior beliefs associated with anomalous and non-anomalous events. The posterior beliefs are updated based on a weighted average of the prior information on the belief itself and the recently observed data.

Subsequently, we propose robust fusion models which utilize the trusts of the nodes to improve the accuracy of the cooperative spectrum sensing decisions. In particular, we propose three fusion models: (i) optimistic trust based fusion, (ii) conservative trust based fusion, and (iii) inversion based fusion. The former two approaches exclude untrustworthy sensing reports for fusion, while the last approach utilizes misleading information. All schemes are analyzed under various attack strategies. We propose an asymmetric weighted moving average based trust management scheme that quickly identifies on-off SSDF attacks and prevents quick trust redemption when such nodes revert back to temporal honest behavior. We also provide insights on what attack strategies are more effective from the adversaries’ perspective.

Through extensive simulation experiments we show that the trust models are effective in identifying malicious nodes with a high degree of certainty under variety of network and radio conditions. We show high true negative detection rates even when multiple malicious nodes launch collaborative attacks which is an improvement over existing voting based exclusion and entropy divergence techniques. We also show that we are able to improve the accuracy of fusion decisions compared to other popular fusion techniques. Trust based fusion schemes show worst case decision error rates of 5% while inversion based fusion show 4% as opposed majority voting schemes that have 18% error rate. We also show that the proposed channel centric Bayesian inference based trust model is able to distinguish between attacked and non-attacked channels for both static and dynamic collaborative attacks. We are also able to show that attacked channels have significantly lower trust
values than channels that are not – a metric that can be used by nodes to rank the quality of inference on channels.

Committee: Mainak Chatterjee (Chair), Ratan Guha, Changchun Zou, Damla Turgut, and Necati Catbas

Graduated Summer 2015
Batch and Online Implicit Weighted Gaussian Processes for Robust Novelty Detection

RUBEN RAMIREZ PADRON
Computer Engineering PhD

This dissertation aims mainly at obtaining robust variants of Gaussian processes (GPs) that do not require using non-Gaussian likelihoods to compensate for outliers in the training data. Bayesian kernel methods, and in particular GPs, have been used to solve a variety of machine learning problems, equating or exceeding the performance of other successful techniques. That is the case of a recently proposed approach to GP-based novelty detection that uses standard GPs (i.e. GPs employing Gaussian likelihoods). However, standard GPs are sensitive to outliers in training data, and this limitation carries over to GP-based novelty detection. This limitation has been typically addressed by using robust non-Gaussian likelihoods. However, non-Gaussian likelihoods lead to analytically intractable inferences, which require using approximation techniques that are typically complex and computationally expensive. Inspired by the use of weights in quasi-robust statistics, this work introduces a particular type of weight functions, called here data weighers, in order to obtain robust GPs that do not require approximation techniques and retain the simplicity of standard GPs. This work proposes implicit weighted variants of batch GP, online GP, and sparse online GP (SOGP) that employ weighted Gaussian likelihoods. Mathematical expressions for calculating the posterior implicit weighted GPs are derived in this work. In our experiments, novelty detection based on our weighted batch GPs consistently and significantly outperformed standard batch GP-based novelty detection whenever data was contaminated with outliers. Additionally, our experiments show that novelty detection based on online GPs can perform similarly to batch GP-based novelty detection. Membership scores previously introduced by other authors are also compared in our experiments.

Committee: Avelino Gonzalez (Chair), Michael Georgiopoulos, Kenneth Stanley, Boris Mederos, and Chung-Ching Wang

Graduated Summer 2015
Opportunistic Spectrum Utilization by Cognitive Radio Networks: Challenges and Solutions

MUHAMMAD FAISAL AMJAD
Computer Science PhD

Cognitive Radio Network (CRN) is an emerging paradigm that makes use of Dynamic Spectrum Access (DSA) to communicate opportunistically, in the un-licensed Industrial, Scientific and Medical bands or frequency bands otherwise licensed to incumbent users such as TV broadcast. Interest in the development of CRNs is because of severe under-utilization of spectrum bands by the incumbent Primary Users (PUs) that have the license to use them coupled with an ever-increasing demand for unlicensed spectrum for a variety of new mobile and wireless applications. The essence of Cognitive Radio (CR) operation is the cooperative and opportunistic utilization of licensed spectrum bands by the Secondary Users (SUs) that collectively form the CRN without causing any interference to PUs’ communications.

CRN operation is characterized by factors such as network-wide quiet periods for cooperative spectrum sensing, opportunistic/dynamic spectrum access and non-deterministic operation of PUs. These factors can have a devastating impact on the overall throughput and can significantly increase the control overheads. Therefore, to support the same level of QoS as traditional wireless access technologies, very closer interaction is required between layers of the protocol stack.

Opportunistic spectrum utilization without causing interference to the PUs is only possible if the SUs periodically sense the spectrum for the presence of PUs’ signal. To minimize the effects of hardware capabilities, terrain features and PUs’ transmission ranges, DSA is undertaken in a collaborative manner where SUs periodically carry out spectrum sensing in their respective geographical locations. Collaborative spectrum sensing has numerous security loopholes and can be favorable to malicious nodes in the network that may exploit vulnerabilities associated with DSA such as launching a spectrum sensing data falsification (SSDF) attack. Some CRN standards such as the IEEE 802.22 wireless regional area network employ a two-stage quiet period mechanism based on a mandatory Fast Sensing and an optional Fine Sensing stage for DSA. This arrangement is meant to strike a balance
between the conflicting goals of proper protection of incumbent PUs’ signals and optimum QoS for SUs so that only as much time is spent for spectrum sensing as needed. Malicious nodes in the CRN however, can take advantage of the two-stage spectrum sensing mechanism to launch smart denial of service (DoS) jamming attacks on CRNs during the fast sensing stage.

Coexistence protocols enable collocated CRNs to contend for and share the available spectrum. However, most coexistence protocols do not take into consideration the fact that channels of the available spectrum can be heterogeneous in the sense that they can vary in their characteristics and quality such as SNR or bandwidth. Without any mechanism to enforce fairness in accessing varying quality channels, ensuring coexistence with minimal contention and efficient spectrum utilization for CRNs is likely to become a very difficult task.

The cooperative and opportunistic nature of communication has many challenges associated with CRNs’ operation. In view of the challenges described above, this dissertation presents solutions including cross-layer approaches, reputation system, optimization and game theoretic approaches to handle (1) degradation in TCP’s throughput resulting from packet losses and disruptions in spectrum availability due non-deterministic use of spectrum by the PUs (2) presence of malicious SUs in the CRN that may launch various attacks on CRNs including SSDF and jamming and (3) sharing of heterogeneous spectrum resources among collocated CRNs without a centralized mechanism to enforce cooperation among otherwise non-cooperative CRNs.

Committee: Changchun Zou (Chair), Mostafa Bassiouni, Damla Turgut, and Chung-Ching Wang

Graduated Spring 2015
Studying and simulating social systems including human groups and societies can be a complex problem. In order to build a model that simulates humans’ actions, it is necessary to consider the major factors that affect human behavior. Norms are one of these factors: social norms are the customary rules that govern behavior in groups and societies. Norms are everywhere around us, from the way people handshake or bow to the clothes they wear. They play a large role in determining our behaviors. Studies on norms are much older than the age of computer science, since normative studies have been a classic topic in sociology, psychology, philosophy and law. Various theories have been put forth about the functioning of social norms. Although an extensive amount of research on norms has been performed during the recent years, there remains a significant gap between current models and models that can explain real-world normative behaviors. Most of the existing work on norms focuses on abstract applications, and very few realistic normative simulations of human societies can be found.

The contributions of this dissertation include the following: 1) a new hybrid technique based on agent-based modeling and Markov Chain Monte Carlo is introduced. This method is used to prepare a smoking case study for applying normative models. 2) This hybrid technique is described using category theory, which is a mathematical theory focusing on relations rather than objects. 3) The relationship between norm emergence in social networks and the theory of tipping points is studied. 4) A new lightweight normative architecture for studying smoking cessation trends is introduced. This architecture is then extended to a more general normative framework that can be used to model real-world normative behaviors. The final normative architecture considers cognitive and social aspects of norm formation in human societies. Normative architectures based on only one of these two
aspects exist in the literature, but a normative architecture that effectively includes both of these two is missing.

Committee: Gita Sukthankar (Chair), Ladislau Boloni, Annie Wu, and Samarth Swarup

Graduated Spring 2015
Modeling User Transportation Patterns Using Mobile Devices

ERFAN DAVAMI
Computer Science PhD

Participatory sensing frameworks use humans and their computing devices as a large mobile sensing network. Dramatic accessibility and affordability have turned mobile devices (smartphone and tablet computers) into the most popular computational machines in the world, exceeding laptops. By the end of 2013, more than 1.5 billion people on earth will have a smartphone. Increased coverage and higher speeds of cellular networks have given these devices the power to constantly stream large amounts of data.

Most mobile devices are equipped with advanced sensors such as GPS, cameras, and microphones. This expansion of smartphone numbers and power has created a sensing system capable of achieving tasks practically impossible for conventional sensing platforms. One of the advantages of participatory sensing platforms is their mobility, since human users are often in motion. This dissertation presents a set of techniques for modeling and predicting user transportation patterns from cell-phone and social media check-ins. To study large-scale transportation patterns, I created a mobile phone app, Kpark, for estimating parking lot occupancy on the UCF campus. Kpark aggregates individual user reports on parking space availability to produce a global picture across all the campus lots using crowdsourcing. An issue with crowdsourcing is the possibility of receiving inaccurate information from users, either through error or malicious motivations. One method of combating this problem is to model the trustworthiness of individual participants to use that information to selectively include or discard data.

This dissertation presents a comprehensive study of the performance of different worker quality and data fusion models with plausible simulated user populations, as well as an evaluation of their performance on the real data obtained from a full release of the Kpark app on the UCF Orlando campus. To evaluate individual trust prediction methods, an algorithm selection portfolio was introduced to take advantage of the strengths of each method and maximize the overall prediction performance.
Like many other crowdsourced applications, user incentivization is an important aspect of creating a successful crowdsourcing workflow. For this project a form of non-monetized incentivization called gamification was used in order to create competition among users with the aim of increasing the quantity and quality of data submitted to the project. This dissertation reports on the performance of Kpark at predicting parking occupancy, increasing user app usage, and predicting worker quality.

Committee: Gita Sukthankar (Chair), Avelino Gonzalez, Hassan Foroosh, and Rahul Sukthankar

Graduated Spring 2015
Exploring 3D User Interface Technologies for Improving the Gaming Experience

ARUN KULSHRESHTH
Computer Science PhD

3D user interface technologies have the potential to make games more immersive and engaging, and thus potentially provide a better user experience to gamers. Although 3D user interface technologies are available for games, it is still unclear how their usage affects game play and if there are any user performance benefits. A systematic study of these technologies in game environments is required to understand how game play is affected and how we can optimize the usage in order to achieve better game play experience.

This dissertation seeks to improve the gaming experience by exploring several 3DUI technologies. In this work, we focused on stereoscopic 3D viewing (to improve viewing experience) coupled with motion based control, head tracking (to make games more engaging), and faster gesture based menu selection (to reduce cognitive burden associated with menu interaction while playing). We first studied each of these technologies in isolation to understand their benefits for games. We present the results of our experiments to evaluate benefits of stereoscopic 3D (when coupled with motion based control) and head tracking in games. We discuss the reasons behind these findings and provide recommendations for game designers who want to make use of these technologies to enhance gaming experiences. We also present the results of our experiments with finger-based menu selection techniques with an aim to find out the fastest technique.

Based on these findings, we custom designed an air-combat game prototype which simultaneously uses stereoscopic 3D, head tracking, and finger-count shortcuts to prove that these technologies could be useful for games if the game is designed with these technologies in mind. Additionally, to enhance depth discrimination and minimize visual discomfort, the game dynamically optimizes stereoscopic 3D parameters (convergence and separation) based on the user’s look direction. We conducted a within subjects experiment where we examined performance data and self-reported data on users perception of the game. Our results indicate that participants performed significantly better when all the 3DUI technologies (stereoscopic 3D, head-tracking and
finger-count gestures) were available simultaneously with head tracking as a dominant factor. We explore the individual contribution of each of these technologies to the overall gaming experience and discuss the reasons behind our findings.

Our experiments indicate that 3D user interface technologies could make gaming experience better if used effectively. The games must be designed to make use of the 3D user interface technologies available in order to provide a better gaming experience to the user. We explored a few technologies as part of this work and obtained some design guidelines for future game designers. We hope that our work will serve as the framework for the future explorations of making games better using 3D user interface technologies.

Committee: Joseph Laviola II (Chair), Charles Hughes, Niels Da Vitoria Lobo, and Maic Masuch

Graduated Spring 2015
Resource Management in Large-scale Systems

ASHKAN PAYA
Computer Science PhD

The focus of this thesis is resource management in large-scale systems. Our primary concerns are energy management and practical principles for self-organization and self-management. The main contributions of our work are:

1. **Models.** We proposed several models for different aspects of resource management, e.g., energy-aware load balancing and application scaling for the cloud ecosystem, hierarchical architecture model for self-organizing and self-manageable systems and a new cloud delivery model based on auction-driven self-organization approach.

2. **Algorithms.** We also proposed several different algorithms for the models described above. Algorithms such as coalition formation, combinatorial auctions and clustering algorithm for scale-free organizations of scale-free networks.

3. **Evaluation.** Eventually we conducted different evaluations for the proposed models and algorithms in order to verify them. All the simulations reported in this thesis had been carried out on different instances and services of Amazon Web Services (AWS).

All of these modules will be discussed in detail in the following chapters respectively.

Committee: Dan Marinescu (Chair), Pawel Wocjan, Mostafa Bassiouni, and Eduardo Mucciolo

Graduated Summer 2015
Modeling Crowd Mobility and Communication in Wireless Networks

GURKAN SOLMAZ
Computer Science PhD

This dissertation presents contributions to the fields of mobility modeling, wireless sensor networks (WSNs) with mobile sinks, and opportunistic communication in theme parks. The two main directions of our contributions are human mobility models and strategies for the mobile sink positioning and communication in wireless networks.

The first direction of the dissertation is related to human mobility modeling. Modeling the movement of human subjects is important to improve the performance of wireless networks with human participants and the validation of such networks through simulations. The movements in areas such as theme parks follow specific patterns that are not taken into consideration by the general purpose mobility models. We develop two types of mobility models of theme park visitors. The first model represents the typical movement of visitors as they are visiting various attractions and landmarks of the park. The second model represents the movement of the visitors as they aim to evacuate the park after a natural or man-made disaster.

The second direction focuses on the movement patterns of mobile sinks and their communication in responding to various events and incidents within the theme park. When an event occurs, the system needs to determine which mobile sink will respond to the event and its trajectory. The overall objective is to optimize the event coverage by minimizing the time needed for the chosen mobile sink to reach the incident area. We extend this work by considering the positioning problem of mobile sinks and preservation of the connected topology. We propose a new variant of $p$-center problem for optimal placement and communication of the mobile sinks. We provide a solution to this problem through collaborative event coverage of the WSNs with mobile sinks. Finally, we develop a network model with opportunistic communication for tracking the evacuation of theme park visitors during disasters. This model involves people with smartphones that store and carry
messages. The mobile sinks are responsible for communicating with the smartphones and reaching out to the regions of the emergent events.

Committee: Damla Turgut (Chair), Mostafa Bassiouni, Ratan Guha, and Brian Goldiez

Graduated Fall 2015
Research on Improving Reliability, Energy Efficiency and Scalability in Distributed and Parallel File Systems

JUNYAO ZHANG
Computer Science PhD

With the increasing popularity of cloud computing and “Big data” applications, current data centers are often required to manage petabytes or exabytes of data. To store this huge amount of data, thousands or tens of thousands storage nodes are required at a single site. This imposes three major challenges for storage system designers: (1) Reliability – node failure in these datacenters is a normal occurrence rather than a rare situation. This makes data reliability a great concern. (2) Energy efficiency – a data center can consume up to 100 times more energy than a standard office building. More than 10% of this energy consumption can be attributed to storage systems. Thus, reducing the energy consumption of the storage system is key to reducing the overall consumption of the data center. (3) Scalability – with the continuously increasing size of data, maintaining the scalability of the storage systems is essential. That is, the expansion of the storage system should be completed efficiently and without limitations on the total number of storage nodes or performance.

This thesis proposes three ways to improve the above three key features for current large-scale storage systems. Firstly, we define the problem of “reverse lookup,” namely finding the list of objects (blocks) for a failed node. As the first step of failure recovery, this process is directly related to the recovery/reconstruction time. While existing solutions use metadata traversal or data distribution reversing methods for reverse lookup, which are either time consuming or expensive, a deterministic block placement can achieve fast and efficient reverse lookup. However, the deterministic placement solutions are designed for centralized, small-scale storage architectures such as RAID etc. Due to their lacking of scalability, they cannot be directly applied in large-scale storage systems. In this paper, we propose Group-Shifted Declustering (G-SD), a deterministic data layout for multi-way replication. G-SD addresses the scalability issue of our previous Shifted Declustering layout and supports fast and efficient reverse lookup.
Secondly, we define a problem: “how to balance the performance, energy, and recovery in degradation mode for an energy efficient storage system?” While extensive researches have been proposed to tradeoff performance for energy efficiency under normal mode, the system enters degradation mode when node failure occurs, in which node reconstruction is initiated. This very process requires a number of disks to be spun up and requires a substantial amount of I/O bandwidth, which will not only compromise energy efficiency but also performance. Without considering the I/O bandwidth contention between recovery and performance, we find that the current energy proportional solutions cannot answer this question accurately. This thesis present PERP, a mathematical model to minimize the energy consumption for a storage systems with respect to performance and recovery. PERP answers this problem by providing the accurate number of nodes and the assigned recovery bandwidth at each time frame.

Thirdly, current distributed file systems such as Google File System(GFS) and Hadoop Distributed File System (HDFS), employ a pseudo-random method for replica distribution and a centralized lookup table (block map) to record all replica locations. This lookup table requires a large amount of memory and consumes a considerable amount of CPU/network resources on the metadata server. With the booming size of “Big Data”, the metadata server becomes a scalability and performance bottleneck. While current approaches such as HDFS Federation attempt to “horizontally” extend scalability by allowing multiple metadata servers, we believe a more promising optimization option is to “vertically” scale up each metadata server. We propose Deister, a novel block management scheme that builds on top of a deterministic declustering distribution method Intersected Shifted Declustering (ISD). Thus both replica distribution and location lookup can be achieved without a centralized lookup table.

Committee: Jun Wang (Chair), Dan Marinescu, Changchun Zou, and Brian Goldiez

Graduated Summer 2015
Finding optimal configuration of power distribution systems topology is an NP-hard combinatorial optimization problem. It becomes more complex when time varying nature of loads in large-scale distribution systems is taken into account. In the second chapter of this dissertation, a systematic approach is proposed to tackle the computational burden of the procedure. To solve the optimization problem, a novel adaptive fuzzy based parallel genetic algorithm (GA) is proposed that employs the concept of parallel computing in identifying the optimal configuration of the network. The integration of fuzzy logic into GA enhances the efficiency of the parallel GA by adaptively modifying the migration rates between different processors during the optimization process. A computationally efficient graph encoding method based on Dandelion coding strategy is developed which automatically generates radial topologies and prevents the construction of infeasible radial networks during the optimization process.

The main shortcoming of the proposed algorithm in Chapter 2 is that it identifies only one single solution. It means that the system operator will not have any option but relying on the found solution. That is why a novel hybrid optimization algorithm is proposed in the third chapter of this dissertation that determines Pareto frontiers, as candidate solutions, for multi-objective distribution network reconfiguration problem. Implementing this model, the system operator will have more flexibility in choosing the best configuration among the alternative solutions. The proposed hybrid optimization algorithm combines the concept of fuzzy Pareto dominance (FPD) with shuffled frog leaping algorithm (SFLA) to recognize non-dominated suboptimal solutions identified by SFLA. The local search step of SFLA is also customized for power systems applications so that it automatically creates and analyzes only the feasible and radial configurations in its optimization procedure which significantly increases the convergence speed of the algorithm.

In the fourth chapter, the problem of optimal network reconfiguration is solved for the case in which the system operator is going to employ an optimization algorithm that is automatically modifying its parameters during
the optimization process. Defining three fuzzy functions, the probability of crossover and mutation will be adaptively tuned as the algorithm proceeds and the premature convergence will be avoided while the convergence speed of identifying the optimal configuration will not decrease. This modified genetic algorithm is considered a step towards making the parallel GA, presented in the second chapter of this dissertation, more robust in avoiding from getting stuck in local optimums.

In the fifth chapter, the concentration will be on finding a potential smart grid solution to more high-quality suboptimal configurations of distribution networks. This chapter is considered an improvement for the third chapter of this dissertation for two reasons: (1) A fuzzy logic is used in the partitioning step of SFLA to improve the proposed optimization algorithm and to yield more accurate classification of frogs. (2) The problem of system reconfiguration is solved considering the presence of distributed generation (DG) units in the network. In order to study the new paradigm of integrating smart grids into power systems, it will be analyzed how the quality of suboptimal solutions can be affected when DG units are continuously added to the distribution network.

The heuristic optimization algorithm which is proposed in Chapter 3 and is improved in Chapter 5 is implemented on a smaller case study in Chapter 6 to demonstrate that the identified solution through the optimization process is the same with the optimal solution found by an exhaustive search.

Committee: Xinzhang Wu (Chair), Saeed Lotfifard (Co-Chair), Michael Haralambous, George Atia, and Jennifer Pazour

Graduated Spring 2015
Performance Optimization of Lateral-mode Thin-film Piezoelectric-on-substrate Resonant Systems

HEDY FATEMI
Electrical Engineering PhD

The main focus of this dissertation is to characterize and improve the performance of thin-film piezoelectric-on-substrate (TPoS) lateral-mode resonators and filters. TPoS is a class of piezoelectric MEMS devices which benefits from the high coupling coefficient of the piezoelectric transduction mechanism while taking advantage of superior acoustic properties of a substrate. The use of lateral-mode TPoS designs allows for fabrication of dispersed-frequency filters on a single substrate, thus significantly reducing the size and manufacturing cost of devices. TPoS filters also offer a lower temperature coefficient of frequency, and better power handling capability compared to rival technologies all in a very small footprint.

Design and fabrication process of the TPoS devices is discussed. Both silicon and diamond substrates are utilized for fabrication of TPoS devices and results are compared. Specifically, the superior acoustic properties of nanocrystalline diamond in scaling the frequency and energy density of the resonators is highlighted in comparison with silicon. The performance of TPoS devices in a variety of applications is reported. These applications include lateral-mode TPoS filters with record low IL values (as low as 2dB) and fractional bandwidth up to 1%, impedance transformers, very low phase noise oscillators, and passive wireless temperature sensors.

Committee: Reza Abdolvand (Chair), Kalpathy Sundaram, Donald Malocha, Xun Gong, and Hyoung Jin Cho

Graduated Fall 2015
A Roughness Correction for Aquarius Ocean Brightness Temperatures Using the CONAE MicroWave Radiometer

YAZAN HEJAZIN
Electrical Engineering PhD

Aquarius/SAC-D is a joint NASA/CONAE (Argentine Space Agency) Earth Sciences satellite mission to measure global sea surface salinity (SSS), using an L-band radiometer that measures ocean brightness temperature (Tb). The application of L-band radiometry to retrieve SSS is a difficult task, and therefore, precise Tb corrections are necessary to obtain accurate measurements. One of the major error sources is the effect of ocean roughness that “warms” the ocean Tb. The Aquarius (AQ) instrument (L-band radiometer/scatterometer) baseline approach uses the radar scatterometer to provide this ocean roughness correction, through the correlation of radar backscatter with the excess ocean emissivity.

In contrast, this dissertation develops an ocean roughness correction for AQ measurements using the MicroWave Radiometer (MWR) instrument Tb measurements at Ka-band to remove the errors that are caused by ocean wind speed and direction. The new ocean emissivity radiative transfer model was tuned using one year (2012) of on-orbit combined data from the MWR and the AQ instruments that are collocated in space and time. The roughness correction in this paper is a theoretical Radiative Transfer Model (RTM) driven by numerical weather forecast model surface winds, combined with ancillary satellite data from WindSat and SSMIS, and environmental parameters from NCEP. This RTM provides an alternative approach for estimating the scatterometer-derived roughness correction, which is independent. The theoretical basis of the algorithm is described and results are compared with the AQ baseline scatterometer method. Also results are presented for a comparison of AQ SSS retrievals using both roughness corrections.

Committee: W. Jones (Chair), Parveen Wahid, Wasfy Mikhael, William Junek, and Jeffrey Piepmeier

Graduated Spring 2015
Towards Improving Human-Robot Interaction for Social Robots

SAAD KHAN
Electrical Engineering PhD

Autonomous robots interacting with humans in a social setting must consider the social-cultural environment when pursuing their objectives. Thus the social robot must perceive and understand the social cultural environment in order to be able to explain and predict the actions of its human interaction partners. This dissertation contributes to the emerging field of human-robot interaction for social robots in the following ways:

1. We used the social calculus technique based on culture sanctioned social metrics (CSSMs) to quantify, analyze and predict the behavior of the robot, human soldiers and the public perception in the Market Patrol peacekeeping scenario.

2. We validated the results of the Market Patrol scenario by comparing the predicted values with the judgment of a large group of human observers cognizant of the modeled culture.

3. We modeled the movement of a socially aware mobile robot in a dense crowds, using the concept of a micro-conflict to represent the challenge of giving or not giving way to pedestrians.

4. We developed an approach for the robot behavior in micro-conflicts based on the psychological observation that human opponents will use a consistent strategy. For this, the mobile robot classifies the opponent strategy reflected by the personality and social status of the person and chooses an appropriate counter-strategy that takes into account the urgency of the robots’ mission.

5. We developed an alternative approach for the resolution of micro-conflicts based on the imitation of the behavior of the human agent. This approach aims to make the behavior of an autonomous robot closely resemble that of a remotely operated one.

Committee: Ladislau Boloni (Chair) Aman Behal, Gita Sukthankar, Ivan Garibay, and Stephen Fiore

Graduated Fall 2015
Electrostatic Discharges (ESD) is a significant hazard to electronic components and systems. Based on a specific process technology, a given circuit application requires a customized ESD consideration that meets all the requirements such as the core circuit’s operating condition, maximum accepted leakage current, breakdown conditions for the process and overall device sizes. In every several years, there will be a new process technology becomes mature, and most of those new technology requires custom design of effective ESD protection solution. And usually the design window will shrinks due to the evolving of the technology becomes smaller and smaller. The ESD related failure is a major IC reliability concern and results in a loss of millions dollars each year in the semiconductor industry. To emulate the real word stress condition, several ESD stress models and test methods have been developed. The basic ESD models are Human Body model (HBM), Machine Mode (MM), and Charge Device Model (CDM). For the system-level ESD robustness, it is defined by different standards and specifications than component-level ESD requirements. International Electrotechnical Commission (IEC) 61000-4-2 has been used for the product and the Human Metal Model (HMM) has been used for the system at the wafer level.

Increasingly stringent design specifications are forcing original equipment manufacturers (OEMs) to minimize the number of off-chip components. This is the case in emerging multifunction mobile, industrial, automotive and healthcare applications. It requires a high level of ESD robustness and the integrated circuit (IC) level, while finding ways to streamline the ESD characterization during early development cycle. To enable predicting the ESD performance of IC’s pins that are directly exposed to a system-level stress condition, a new human metal model (HMM) test model has been introduced. In this work, a new testing methodology for product-level HMM characterization is introduced. This testing framework allows for consistently identifying ESD-induced failures in a product, substantially simplifying the testing process, and significantly reducing the product.
evaluation time during development cycle. It helps eliminates the potential inaccuracy provided by the conventional characterization methodology. For verification purposes, this method has been applied to detect the failures of two different products.

Addition to the exploration of new characterization methodology that provides better accuracy, we also have looked into the protection devices itself. ICs for emerging high performance precision data acquisition and transceivers in industrial, automotive and wireless infrastructure applications require effective and ESD protection solutions. These circuits, with relatively high operating voltages at the Input/Output (I/O) pins, are increasingly being designed in low voltage Complementary Metal-Oxide-Semiconductor (CMOS) technologies to meet the requirements of low cost and large scale integration. A new dual-polarity SCR optimized for high bidirectional blocking voltages, high trigger current and low capacitance is realized in a sub 3-V, 180-nm CMOS process. This ESD device is designed for a specific application where the operating voltage at the I/O is larger than that of the core circuit. For instance, protecting high voltage swing I/Os in CMOS data acquisition system (DAS) applications. In this reference application, an array of thin film resistors voltage divider is directly connected to the interface pin, reducing the maximum voltage that is obtained at the core device input down to ±1-5 V. Its ESD characteristics, including the trigger voltage and failure current, are compared against those of a typical CMOS-based SCR.

Then, we have looked into the ESD protection designs into more advanced technology, the 28-nm CMOS. An ESD protection design builds on the multiple discharge-paths ESD cell concept and focuses the attention on the detailed design, optimization and realization of the in-situ ESD protection cell for IO pins with variable operation voltages. By introducing different device configurations fabricated in a 28-nm CMOS process, a greater flexibility in the design options and design trade-offs can be obtained in the proposed topology, thus achieving a higher integration and smaller cell size definition for multi-voltage compatibility interface ESD protection applications. This device is optimized for low capacitance and synthesized with the circuit IO components for in-situ ESD protection in communication interface applications developed in a 28-nm, high-k, and metal-gate CMOS technology.

ESD devices have been used in different types of applications and also at different environment conditions, such as high temperature. At the last
section of this research work, we have performed an investigation of several different ESD devices’ performance under various temperature conditions. And it has been shown that the variations of the device structure can result in different ESD performance, and some devices can be used at the high temperature and some cannot. And this investigation also brings up a potential threat to the current ESD protection devices that they might be very vulnerable to the latch-up issue at the higher temperature range.

Committee: Juin Liou (Chair), Jiann-Shiun Yuan, Xun Gong, Yier Jin, and Javier Salcedo

Graduated Spring 2015
Post Conversion Correction of Non-Linear Mismatches for Time Interleaved Analog-to-Digital Converters

CHARNA PARKEY
Electrical Engineering PhD

Time Interleaved Analog-to-Digital Converters (TI-ADCs) utilize an architecture which enables conversion rates well beyond the capabilities of a single converter while preserving most or all of the other performance characteristics of the converters on which said architecture is based. Most of the approaches discussed here are independent of architecture; some solutions take advantage of specific architectures. Chapter 1 provides the problem formulation and reviews the errors found in ADCs as well as a brief literature review of available TI-ADC error correction solutions. Chapter 2 presents the methods and materials used in implementation as well as extend the state of the art for post conversion correction. Chapter 3 presents the simulation results of this work and Chapter 4 concludes the work. The contribution of this research is three fold: A new behavioral model was developed in Simulink™ and MATLAB™ to model and test linear and nonlinear mismatch errors emulating the performance data of actual converters. The details of this model are presented as well as the results of cumulant statistical calculations of the mismatch errors which is followed by the detailed explanation and performance evaluation of the extension developed in this research effort. Leading post conversion correction methods are presented and an extension with derivations is presented. It is shown that the data converter subsystem architecture developed is capable of realizing better performance of those currently reported in the literature while having a more efficient implementation.

Committee: Wasfy Mikhael (Chair), Zhihua Qu, Michael Georgiopoulos, Brent Myers, Lei Wei, and David Chester

Graduated Spring 2015
Design of Novel Devices and Circuits for Electrostatic Discharge Protection Applications in Advanced Semiconductor Technologies

ZHIXIN WANG
Electrical Engineering PhD

Electrostatic Discharge (ESD), as a subset of Electrical Overstress (EOS), was reported to be in charge of more than 35% of failure in integrated circuits (ICs). Especially in the manufacturing process, the silicon wafer turns out to be a functional ICs after numerous physical, chemical and mechanical processes, each of which expose the sensitive and fragile ICs to ESD environment. In normal end-user applications, ESD from human and machine handling, surge and spike signals in the power supply, and wrong supplying signals, will probably cause severe damage to the ICs and even the whole systems.

Generally, ESD protections are evaluated after wafer and even system fabrication, increasing the development period and cost if the protections cannot meet customer’s requirements. Therefore, it is important to design and customize robust and area-efficient ESD protections for the ICs at the early development stage. As the technologies generally scaling down, however, ESD protection clamps remain comparable area consumption in the recent years because they provide the discharging path for the ESD energy which rarely scales down. Diode is the most simple and effective device for ESD protection in ICs, but the usage is significantly limited by its low turn-on voltage. MOS devices can be triggered by a dynamic-triggered RC circuit for IOs operating at low voltage, while the one triggered by a static-triggered network, e.g., zener-resistor circuit or grounded-gate configuration, provides a high trigger voltage for high-voltage applications. However, the relatively low current discharging capability makes MOS devices as the secondary choice. Silicon-controlled rectifier (SCR) has become famous due to its high robustness and area efficiency, compared to diode and MOS. In this dissertation, a comprehensive design methodology for SCR based on simulation and measurement are presented for different advanced commercial technologies. Furthermore, an ESD clamp is designed and verified for the first time for the emerging GaN technology.
For the SCR, no matter what modification is going to be made, the first concern when drawing the layout is to determine the layout geometrical style, finger width and finger number. This problem for diode and MOS device were studied in detail, so the same method was usually used in SCR. The research in this dissertation provides a closer look into the metal layout effect to the SCR, finding out the optimized robustness and minimized side-effect can be obtained by using specific layout geometry. Another concern about SCR is the relatively low turn-on speed when the IOs under protection is stressed by ESD pulses having very fast rising time, e.g., CDM and IEC 61000-4-2 pulses. On this occasion a large overshoot voltage is generated and cause damage to internal circuit component like gate oxides of MOS devices. The key determination of turn-on speed of SCR is physically investigated, followed by a novel design on SCR by directly connecting the Anode Gate and Cathode Gate to form internal trigger (DCSCR), with improved performance verified experimentally in this dissertation. The overshoot voltage and trigger voltage of the DCSCR will be significantly reduced, in return a better protection for internal circuit component is offered without scarifying neither area or robustness.

Even though two SCR’s with single direction of ESD current path can be constructed in reverse parallel to form bidirectional protection to pins, stand-alone bidirectional SCR (BSCR) is always desirable for sake of smaller area. The inherent high trigger voltage of BSCR that only fit in high-voltage technologies is overcome by embedding a PMOS transistor as trigger element, making it highly suitable for low-voltage ESD protection applications. More than that, this modification simultaneously introduces benefits including high robustness and low overshoot voltage.

For high voltage pins, however, it presents another story for ESD designs. The high operation voltages require that a high trigger voltage and high holding voltage, so as to reduce the false trigger and latch-up risk. For several capacitive pins, the displacement current induced by a large snapback will cause severe damage to internal circuits. A novel design on SCR is proposed to minimize the snapback with adjustable trigger and holding voltage. Thanks to the additional a PIN diode, the similar high robustness and stable thermal leakage performance to SCR is maintained.

For academic purpose of ESD design, it is always difficult to obtain the complete process deck in TCAD simulation because those information are highly confidential to the companies. Another challenge of using TCAD is
the difficulty of maintaining the accuracy of physics models and predicting the performance of the other structures. In this dissertation a TCAD-aid ESD design methodology is used to evaluate ESD performance before the silicon shuttle.

GaN is a promising material for high-voltage high-power RF application compared to the GaAs. However, distinct from GaAs, the leaky problem of the schottky junction and the lack of choice of passive/active components in GaN technology limit the ESD protection design, which will be discussed in this dissertation. However, a promising ESD protection clamp is finally developed based on depletion-mode pHEMT with adjustable trigger voltage, reasonable leakage current and high robustness.

Committee: Juin Liou (Chair), Xun Gong, Jiann-Shiun Yuan, Yier Jin, and James Vinson

Graduated Spring 2015
Lyapunov-Based Robust and Adaptive Control Design for Nonlinear Uncertain Systems

KUN ZHANG
Electrical Engineering PhD

The control of systems with uncertain nonlinear dynamics is an important field of control science attracting decades of focus. In this dissertation, four different control strategies are presented using sliding mode control, adaptive control, dynamic compensation, and neural network for a nonlinear aeroelastic system with bounded uncertainties and external disturbance. In Chapter 2, partial state feedback adaptive control designs are proposed for two different aeroelastic systems operating in unsteady flow. In Chapter 3, a continuous robust control design is proposed for a class of single input and single output system with uncertainties. An aeroelastic system with a trailing-edge flap as its control input will be considered as the plant for demonstration of effectiveness of the controller. The controller is proved to be robust by both athematical proof and simulation results. In Chapter 3, a robust output feedback control strategy is discussed for the vibration suppression of an aeroelastic system operating in an unsteady incompressible flowfield. The aeroelastic system is actuated using a combination of leading-edge (LE) and trailing-edge (TE) flaps in the presence of different kinds of gust disturbances. In Chapter 5, a neural-network based model-free controller is designed for an aeroelastic system operating at supersonic speed. The controller is shown to be able to effectively asymptotically stabilize the system via both a Lyapunov-based stability proof and numerical simulation results.

Committee: Aman Behal (Chair), Michael Haralambous, Yunjun Xu, Ladislau Boloni, and Piergiovanni Marzocca

Graduated Spring 2015
Mathematical Modeling of Carbon Removal in the A-Stage Activated Sludge System

THOMAS NOGAJ
Environmental Engineering PhD

This research developed a dynamic activated sludge model (ASM) to better describe the overall removal of organic substrate, quantified as chemical oxygen demand (COD), from A-stage high rate activated sludge (HRAS) systems. This dynamic computer model is based on a modified ASM1 (Henze et al., 2000) model. It was determined early in the project that influent soluble COD, which is normally represented by a single state variable in ASM1, had to be subdivided into two state variables ($S_{B_s}$ and $S_{B_f}$, or slow and fast fractions) to simulate the performance of A-stage systems. Also, the addition of state variables differentiating colloidal COD from suspended COD was necessary due to short hydraulic residence times in A-stage systems which do not allow for complete enmeshment and bioflocculation of these particles as occurs in conventional activated sludge systems (which have longer solid retention times and hydraulic retention times). It was necessary to add several processes (both stoichiometry and kinetic equations) to the original ASM1 model including heterotrophic growth on both soluble substrate fractions and bioflocculation of colloidal solids. How to properly quantify heterotrophic growth on $S_{B_s}$ and $S_{B_f}$ resulted in two separate approaches with respect to process kinetic equations. In one approach the $S_{B_f}$ was metabolized preferentially over $S_{B_s}$ which was only utilized when $S_{B_f}$ was not available. This is referred to as the Diauxic Model. In the other approach $S_{B_f}$ and $S_{B_s}$ were metabolized simultaneously, and this is referred to as the Dual Substrate Model. The Dual Substrate Model calibrated slightly better than the Diauxic Model for one of the two available pilot studies data sets (the other set was used for model verification).

The Dual Substrate A-stage model was used to describe the effects of varying specific operating parameters including solids retention time (SRT), dissolved oxygen (DO), influent COD and temperature on the effluent COD:N ratio. The effluent COD:N ratio target was based on its suitability for a downstream nitrite shunt (i.e. nitritation/denitritation) process. In the downstream process the goal is to eliminate nitrite oxidizing bacteria (NOB) from the reactor while selecting for ammonia oxidizing bacteria (AOB). The
results showed that a low SRT (<0.25 d) can produce high effluent substrates ($S_B$ and $C_B$), and elevated COD:N ratios consistent with NOB out-selection downstream, the HRAS model was able to predict the measured higher fraction of $C_B$ in the A-stage effluent at lower SRTs and DO concentrations, and to achieve the benefits of operating an A-stage process, while maintaining an effluent COD:N ratio suitable for a downstream nitritation/denitritation process, an A-stage SRT in the range of 0.1 to 0.25 d should be maintained.

This research also included an analysis of A-stage pilot data using stoichiometry to determine the bio-products formed from soluble substrate removed in an A-stage reactor. The results were used to further refine the process components and stoichiometric parameters to be used in the A-stage dynamic computer model, which includes process mechanisms for flocculation and enmeshment of particulate and colloidal substrate, hydrolysis, production of extracellular polymeric substances (EPS) and storage of soluble biodegradable substrate. Analysis of pilot data and simulations with the dynamic computer model implied (indirectly) that storage products were probably significant in A-stage COD removal.

Committee: Andrew Randall (Chair), Steven Duranceau, Manoj Chopra, and Jose Jimenez

Graduated Spring 2015
Aircraft maintenance is viewed as a critical safety component in general and military aviation industries, and thus it is crucial to identify the factors that may affect aircraft maintenance. Because the safety climate is considered as a leading indicator of safety performance and safety outcomes, this study utilized this safety climate approach to develop a model which can explain the relationships between employee turnover, safety motivation, self-reported unsafe acts, reporting unsafe behaviors, incidents, and injuries in the aviation maintenance environment. This study included a sample of 283 technicians in military aircraft maintenance units who participated in a cross-sectional random survey. Data collected were analyzed using Exploratory Factor Analysis (EFA) and Structural Equation Modeling (SEM) techniques. A structural model that fitted the data was developed which predicted 64% of the variance in employee turnover, 7% of the variance in safety motivation, 20% of the variance in unsafe acts, 41% of the variance in reporting unsafe behavior, and 21% of the variance in workplace injuries. The results indicate employees who report a perception of high turnover exhibit decreased safety motivation and increased unsafe acts which lead to higher levels of workplace injuries. The perception of safety climate was identified as an antecedent to safety performance and safety outcomes. Additionally, the effects of control variables such as age and education were tested. The implications for safety management in aircraft maintenance were also discussed. This study provides directions for future research on the turnover of aircraft maintenance technicians, safety performance, and safety outcomes.

Committee: Waldemar Karwowski (Chair), Petros Xanthopoulos, Peter Hancock, and Piotr Mikusinski

Graduated Summer 2015
The Relationship Between DNA’s Physical Properties and the DNA Molecule’s Harmonic Signature, and Related Motion in Water—A Computational Investigation

VICTOR BOYER
Industrial Engineering PhD

This research investigates through computational methods whether the physical properties of DNA contribute to its harmonic signature, the uniqueness of that signature if present, and motion of the DNA molecule in water. When DNA is solvated in water at normal ‘room temperature’, it experiences a natural vibration due to the Brownian motion of the particles in the water colliding with the DNA. The null hypothesis is that there is no evidence to suggest a relationship between DNA’s motion and strand length, while the alternative hypothesis is that there is evidence to suggest a relationship between DNA’s vibrational motion and strand length. In a similar vein to the first hypothesis, a second hypothesis posits that DNA’s vibrational motion may be dependent on strand content. The nature of this relationship, whether linear, exponential, logarithmic or non-continuous is not hypothesized by this research but will be discovered by testing if there is evidence to suggest a relationship between DNA’s motion and strand length. The research also aims to discover whether the motion of DNA, when it varies by strand length and/or content, is sufficiently unique to allow that DNA to be identified in the absence of foreknowledge of the type of DNA that is present in a manner similar to a signature. If there is evidence to suggest that there is a uniqueness in DNA’s vibrational motion under varying DNA strand content or length, then additional experimentation will be needed to determine whether these variances are unique across small changes as well as large changes, or large changes only. Finally, the question of whether it might be possible to identify a strand of unique DNA by base pair configuration solely from its vibrational signature, or if not, whether it might be possible to identify changes existing inside of a known DNA strand (such as a corruption, transposition or mutational error) is explored. Given the computational approach to this research, the NAMD simulation package (released by the Theoretical and Computational Biophysics Group at the University of Illinois at Urbana-Champaign) with the CHARMM force field would be the most appropriate set of tools for this investigation (Phillips et al., 2005), and will therefore be the toolset used in this research.
For visualization and manipulation of model data, the VMD (Visual Molecular Dynamics) package will be employed. Further, these tools may be optimized and/or be aware of nucleic acid structures, and are free. These tools appear to be sufficient for this task, with validated fidelity of the simulation to provide vibrational and pressure profile data that could be analyzed; sufficient capabilities to do what is being asked of it; speed, so that runs can be done in a reasonable period of time (weeks versus months); and parallelizability, so that the tool could be run over a clustered network of computers dedicated to the task to increase the speed and capacity of the simulations. The computer cluster enabled analysis of 30,000 to 40,000 atom systems spending more than 410,000 CPU computational hours of hundreds of nano second duration, experimental runs each sampled 500,000 times with two-femtosecond “frames.”

Using Fourier transforms of run pressure readings into frequencies, the simulation investigation could not reject the null hypotheses that the frequencies observed in the system runs are independent on the DNA strand length or content being studied. To be clear, frequency variations were present in the in silicon replications of the DNA in ionized solutions, but we were unable to conclude that those variations were not due to other system factors. There were several tests employed to determine alternative factors that caused these variations. Chief among the factors is the possibility that the water box itself is the source of a large amount of vibrational noise that makes it difficult or impossible with the tools that we had at our disposal to isolate any signals emitted by the DNA strands. Assuming the water-box itself was a source of large amounts of vibrational noise, an emergent hypothesis was generated and additional post-hoc testing was undertaken to attempt to isolate and then filter the water box noise from the rest of the system frequencies. With conclusive results we found that the water box is responsible for the majority of the signals being recorded, resulting in very low signal amplitudes from the DNA molecules themselves. Using these low signal amplitudes being emitted by the DNA, we could not be conclusively uniquely associate either DNA length or content with the remaining observed frequencies. A brief look at a future possible isolation technique, wavelet analysis, was conducted. Finally, because these results are dependent on the tools at our disposal and hence by no means conclusive, suggestions
for future research to expand on and further test these hypothesis are made in the final chapter.

Committee: Michael Proctor (Chair), William Thompson, Waldemar Karwowski, and Richard Calloway

Graduated Fall 2015
A New Paradigm Integrating Business Process Modeling and Use Case Modeling

BARCLAY BROWN
Industrial Engineering PhD

The goal of this research is to develop a new paradigm integrating the practices of business process modeling and use case modeling. These two modeling approaches describe the behavior of organizations and systems, and their interactions, but rest on different paradigms and serve different needs. The base of knowledge and information required for each approach is largely common, however, so an integrated approach has advantages in efficiency, consistency and completeness of the overall behavioral model.

Both modeling methods are familiar and widely used. Business process modeling is often employed as a precursor to the development of a system to be used in a business organization. Business process modeling teams and stakeholders may spend months or years developing detailed business process models, expecting that these models will provide a useful base of information for system designers. Unfortunately, as the business process model is analyzed by the system designers, it is found that information needed to specify the functionality of the system does not exist in the business process model. System designers may then employ use case modeling to specify the needed system functionality, again spending significant time with stakeholders to gather the needed input. Stakeholders find this two-pass process redundant and wasteful of time and money since the input they provide to both modeling teams is largely identical, with each team capturing only the aspects relevant to their form of modeling. Developing a new paradigm and modeling approach that achieves the objectives of both business process modeling and use case modeling in an integrated form, in one analysis pass, results in time savings, increased accuracy and improved communication among all participants in the systems development process.

Analysis of several case studies will show that inefficiency, wasted time and overuse of stakeholder resource time results from the separate application of business process modeling and use case modeling. A review of existing literature on the subject shows that while the problem of modeling both business process and use case information in a coordinated fashion has been recognized before, there are few if any approaches that have been proposed.
to reconcile and integrate the two methods. Based on both literature review and good modeling practices, a list of goals for the new paradigm and modeling approach forms the basis for the paradigm to be created.

A grounded theory study is then conducted to analyze existing modeling approaches for both business processes and use cases and to provide an underlying theory on which to base the new paradigm. The two main innovations developed for the new paradigm are the usage process and the timebox. Usage processes allow system usages (use cases) to be identified as the business process model is developed, and the two to be shown in a combined process flow. Timeboxes allow processes to be positioned in time-relation to each other without the need to combine processes into higher level processes using causal relations that may not exist. The combination of usage processes and timeboxes allows any level of complex behavior to be modeled in one pass, without the redundancy and waste of separate business process and use case modeling work.

Several pilot projects are conducted to test the new modeling paradigm in differing modeling situations with participants and subject matter experts asked to compare the traditional models with the new paradigm formulations.

Committee: Waldemar Karwowski (Chair), William Thompson, Gene Lee, and Thomas O’Neal

Graduated Spring 2015
The Effects of Chronic Sleep Deprivation on Sustained Attention: A Study of Brain Dynamic Functional Connectivity

YILING HE
Industrial Engineering PhD

It is estimated that about 35-40% of adults in the U.S. suffer from insufficient sleep. Chronic sleep deprivation has become a prevalent phenomenon because of contemporary lifestyle and work-related factors. Sleep deprivation can reduce the capabilities and efficiency of attentional performance by impairing perception, increasing effort to maintain concentration, as well as introducing vision disturbance. Thus, it is important to understand the neural mechanisms behind how chronic sleep deprivation impairs sustained attention.

In recent years, more attention has been paid to the study of the integration between anatomically distributed and functionally connected brain regions. Functional connectivity has been widely used to characterize brain functional integration, which measures the statistical dependency between neurophysiological events of the human brain. Further, evidence from recent studies has shown the non-stationary nature of brain functional connectivity, which may reveal more information about the human brain. Thus, the objective of this thesis is to investigate the effects of chronic sleep deprivation on sustained attention from the perspective of dynamic functional connectivity.

A modified spatial cueing paradigm was used to assess human sustained attention in rested wakefulness and chronic sleep deprivation conditions. Partial least squares approach was applied to distinguish brain functional connectivity for the experimental conditions. With the integration of a sliding-window approach, dynamic patterns of brain functional connectivity were identified in two experimental conditions. The brain was modeled as a series of dynamic functional networks in each experimental condition. Graph theoretic analysis was performed to investigate the dynamic properties of brain functional networks, using network measures of clustering coefficient and characteristics path length.
In the chronic sleep deprivation condition, a compensation mechanism between highly clustered organization and ineffective adaptability of brain functional networks was observed. Specifically, a highly clustered organization of brain functional networks was illustrated with a large clustering coefficient. This organization suggested that brain utilizes more connections to maintain attention in the chronic sleep deprivation condition. A smaller impact of clustering coefficient variation on characteristics path lengths indicated an ineffective adaptability of brain functional networks in the chronic sleep deprivation condition.

In the rested wakefulness condition, brain functional networks showed the small-world topology in general, with the average small-world topology index larger than one. Small-world topology was identified as an optimal network structure with the balance between local information processing and global integration. Given the fluctuating values of the index over time, small-world brain networks were observed in most cases, indicating an effective adaptability of the human brain to maintain the dominance of small-world networks in the rested wakefulness condition. On the contrary, given that the average small-world topology index was smaller than one, brain functional networks generally exhibited random network structure. From the perspective of dynamic functional networks, even though there were few cases showing small-world brain networks, brain functional networks failed to maintain the dominance of small-world topology in the chronic sleep deprivation condition.

In conclusion, to the best of our knowledge this thesis was the first to investigate the effects of chronic sleep deprivation on sustained attention from the perspective of dynamic brain functional connectivity. A compensation mechanism between highly clustered organization and ineffective adaptability of brain functional networks was observed in the chronic sleep deprivation condition. Furthermore, chronic sleep deprivation impaired sustained attention by reducing the effectiveness of brain functional networks’ adaptability, resulting in the disrupted dominance of small-world brain networks.

Committee: Waldemar Karwowski (Chair), Petros Xanthopoulos (Co-Chair), Peter Hancock, and Piotr Mikusinski

Graduated Spring 2015
Historically, the United States (US) electric grid has been a stable one-way power delivery infrastructure that supplies centrally-generated electricity to its predictably consuming demand. However, the US electric grid is now undergoing a huge transformation from a simple and static system to a complex and dynamic network, which is starting to interconnect intermittent distributed energy resources (DERs), portable electric vehicles (EVs), and load-altering home automation devices, that create bidirectional power flow or stochastic load behavior. In order for this grid of the future to effectively embrace the high penetration of these disruptive and fast-responding digital technologies without compromising its safety, reliability, and affordability, plug-and-play interoperability within the field area network must be enabled between operational technology (OT), information technology (IT), and telecommunication assets in order to seamlessly and securely integrate into the electric utility’s operations and planning systems in a modular, flexible, and scalable fashion.

This research proposes a potential approach to simplifying the translation and contextualization of operational data on the electric grid without being routed to the utility datacenter for a control decision. This methodology integrates modern software technology from other industries, along with utility industry-standard semantic models, to overcome information siloes and enable interoperability. By leveraging industrial engineering tools, a framework is also developed to help devise a reference architecture and use-case application process that is applied and validated at a US electric utility.

Committee: Luis Rabelo (Chair), Qipeng Zheng, Petros Xanthopoulos, and Richard Ajayi

Graduated Spring 2015
Modeling and Analysis of Automated Storage and Retrievals System with Multiple In-the-aisle Pick Positions

FARAZ RAMTIN
Industrial Engineering PhD

This dissertation focuses on developing analytical models for automated storage and retrieval system with multiple in-the-aisle pick positions (MIAPP-AS/RS). Specifically, our first contribution develops an expected travel time model for different pick positions and different physical configurations for a random storage policy. This contribution has been accepted for publication in IIE Transactions (Ramtin & Pazour, 2014) and was the featured article in the IE Magazine (Askin & Nussbaum, 2014). The second contribution addresses an important design question associated with MIAPP-AS/RS, which is the assignment of items to pick positions in an MIAPP-AS/RS. This contribution has been accepted for publication in IIE Transactions (Ramtin & Pazour, 2015). Finally, the third contribution is to develop travel time models and to determine the optimal SKUs to storage locations assignment under different storage assignment policies such as dedicated and class-based storage policies for MIAPP-AS/RS.

An MIAPP-AS/RS is a case-level order-fulfillment technology that enables order picking via multiple pick positions (outputs) located in the aisle. We develop expected travel time models for different operating policies and different physical configurations. These models can be used to analyze MIAPP-AS/RS throughput performance during peak and non-peak hours. Moreover, closed-form approximations are derived for the case of an infinite number of pick positions, which enable us to derive the optimal shape configuration that minimizes expected travel times. We compare our expected travel time models with a simulation model of a discrete rack, and the results validate that our models provide good estimates. Finally, we conduct a numerical experiment to illustrate the trade-offs between performance of operating policies and design configurations. We find that MIAPP-AS/RS with a dual picking floor and input point is a robust configuration because a single command operating policy has comparable throughput performance to a dual command operating policy.
As a second contribution, we study the impact of selecting different pick position assignments on system throughput, as well as system design trade-offs that occur when MIAPP-AS/RS is running under different operating policies and different demand profiles. We study the impact of product to pick position assignments on the expected throughput for different operating policies, demand profiles, and shape factors. We develop efficient algorithms of complexity $O(n \log(n))$ that provide the assignment that minimizes the expected travel time. Also, for different operating policies, shape configurations, and demand curves, we explore the structure of the optimal assignment of products to pick positions and quantify the difference between using a simple, practical assignment policy versus the optimal assignment. Finally, we derive closed-form analytical travel time models by approximating the optimal assignment’s expected travel time using continuous demand curves and assuming an infinite number of pick positions in the aisle. We illustrate that these continuous models work well in estimating the travel time of a discrete rack and use them to find optimal design configurations.

As the third and final contribution, we study the impact of dedicated and class-based storage policy on the performance of MIAPP-AS/RS. We develop mathematical optimization models to minimize the travel time of the crane by changing the assignment of the SKUs to pick positions and storage locations simultaneously. We develop a more tractable solution approach by applying a Benders decomposition approach, as well as an accelerated procedure for the Benders algorithm. We observe high degeneracy for the optimal solution when we use chebyshev metric to calculate the distances. As the result of this degeneracy, we realize that the assignment of SKUs to pick positions does not impact the optimal solution. We also develop closed-form travel time models for MIAPP-AS/RS under a class-based storage policy.

Committee: Jennifer Pazour (Chair), Charles Reilly, Petros Xanthopoulos, and Stephen Goodman

Graduated Spring 2015
Body Mass Bias Mitigation for Females in Military Physical Readiness Testing through Load Carriage Implementation

AARON YEATON
Industrial Engineering PhD

The US Military requires specific fitness testing, known as the Physical Readiness Test (PRT), for its members to determine their overall fitness levels. The test currently being used has been shown to have bias towards heavier mass individuals of up to 20%. Prior research has been completed and several recommendations have been made to eliminate mass bias, but this has been conducted almost exclusively on males. There is very little data and research on military physical fitness testing for women besides combat specific evolution exercises. A possibility exists to eliminate the bias for females through implementing load carriage during PRT events. A specified load is to be placed on women while performing the PRT and compared to a non-loaded control test. The results should show if the load carriage devised has a beneficial effect on current testing methods through eliminating the mass bias for women.

Committee: Pamular McCauley (Chair), Luis Rabelo, Gene Lee, and Nancy Cummings

Graduated Fall 2015
The Influence of Alloying Additions on Diffusion and Strengthening of Magnesium

CATHERINE KAMMERER
Materials Science and Engineering PhD

Magnesium alloys are being developed as advanced materials for structural applications where reduced weight is a primary motivator. Alloying can enhance the properties of magnesium without significantly affecting its density. Essential to alloy development, inclusive of processing parameters, is knowledge of thermodynamic, kinetic, and mechanical behavior of the alloy and its constituents. Appreciable progress has been made through conventional development processes, but to accelerate development of suitable wrought Mg alloys, an integrated Materials Genomic approach must be taken where thermodynamics and diffusion kinetic parameters form the basis of alloy design, process development, and properties-driven applications.

The objective of this research effort is twofold: first, to codify the relationship between diffusion behavior, crystal structure, and mechanical properties; second, to provide fundamental data for the purpose of wrought Mg alloy development. Together, the principal deliverable of this work is an advanced understanding of Mg systems. To that end, the objective is accomplished through an aggregate of studies. The solid-to-solid diffusion bonding technique is used to fabricate combinatorial samples of Mg-Al-Zn ternary and Mg-Al, Mg-Zn, Mg-Y, Mg-Gd, and Mg-Nd binary systems. The combinatorial samples are subjected to structural and compositional characterization via Scanning Electron Microscopy with X-ray Energy Dispersive Spectroscopy, Electron Probe Microanalysis, and analytical Transmission Electron Microscopy. Interdiffusion in binary Mg systems is determined by Sauer-Freise and Boltzmann-Matano methods. Kirkaldy’s extension of the Boltzmann-Matano method, on the basis of Onsager’s formalism, is employed to quantify the main- and cross-interdiffusion coefficients in ternary Mg solid solutions. Impurity diffusion coefficients are determined by way of the Hall method. The intermetallic compounds and solid solutions formed during diffusion bonding of the combinatorial samples are subjected to nanoindentation tests, and the nominal and compositionally dependent mechanical properties are extracted by the Oliver-Pharr method.
In addition to bolstering the scanty available experimental data and first-principles computations, this work delivers several original contributions to the state of Mg alloy knowledge. The influence of Zn concentration on Al impurity diffusion in binary Mg(Zn) solid solution is quantified to impact both the pre-exponential factor and activation energy. The main- and cross-interdiffusion coefficients in the ternary Mg solid solution of Mg-Al-Zn are reported wherein the interdiffusion of Zn is shown to strongly influence the interdiffusion of Mg and Al. A critical examination of rare earth element additions to Mg is reported, and a new phase in thermodynamic equilibrium with Mg-solid solution is identified in the Mg-Gd binary system. It is also demonstrated that Mg atoms move faster than Y atoms. For the first time the mechanical properties of intermetallic compounds in several binary Mg systems are quantified in terms of hardness and elastic modulus, and the influence of solute concentration on solid solution strengthening in binary Mg alloys is reported. The most significant and efficient solid solution strengthening is achieved by alloying Mg with Gd. The Mg-Nd and Mg-Gd intermetallic compounds exhibited better room temperature creep resistance than intermetallic compounds of Mg-Al. The correlation between the concentration dependence of mechanical properties and atomic diffusion is deliberated in terms of electronic nature of the atomic structure.

Committee: Yongho Sohn (Chair), Kevin Coffey, Suryanarayana Challapalli, Yuanli Bai, and Richard Blair

Graduated Summer 2015
Reactive Sputter Deposition of Lithium Phosphorus Oxynitride Thin Films, a Li Battery Solid State Electrolyte

PRABHU DOSS MANI
Materials Science and Engineering PhD

Lithium phosphorus oxy-nitride (LiPON) thin films are widely studied and used as a thin film electrolyte for lithium ion battery applications. LiPON thin films may be prepared by many techniques, but RF sputter deposition is most frequently used and was investigated in this dissertation, in spite of its low deposition rate, because of its offers more reliable and controllable processing. This dissertation includes the methodologies of sputter deposition and materials characterization of the LiPON thin film electrolytes.

The LiPON thin films were deposited under varying conditions of process gas, substrate bias, and deposition temperature. To understand the variations in ionic conductivity observed, the films were extensively characterized to examine structural and compositional differences, including examination by x-ray photoelectron spectroscopy (XPS), inductively coupled plasma optical emission spectroscopy (ICP/OES), and spectroscopic ellipsometry. In addition, film density, and the intrinsic stress of the deposited films were also studied.

The highest ionic conductivity of $9.8 \times 10^{-6}$ S/cm was obtained at elevated deposition temperature and is correlated to a reduced density of defects, as indicated from the optical characterization.

Committee: Kevin Coffey (Chair), Helge Heinrich, James Hickman, and Kalpathy Sundaram

Graduated Summer 2015
Nanoarchitectured Energy Storage Devices

ZENAN YU
Materials Science and Engineering PhD

Supercapacitors, the devices that connect the gap between batteries and conventional capacitors, have recently attracted significant attention due to their high specific capacitance, substantially enhanced power and energy densities, and extraordinary cycle life. In order to realize even better performance with supercapacitors, rejuvenated effort towards developing nanostructured electrodes is necessary.

In this dissertation, several strategic directions of nanoarchitecturing the electrodes to enhance the performance of supercapacitors are investigated. An introduction and background of supercapacitors, which includes motivation, classification and working principles, recent nanostructured electrode materials studies, and devices fabrication, are initially presented. A facile method, called Spin-on Nanoprinting (SNAP), to fabricate highly ordered manganese dioxide (MnO$_2$) nanopillars is introduced. The SNAP method that is further modified to develop carbon nanoarray electrodes is also discussed. Subsequently, a template-free method to develop high aspect ratio copper oxide nanowhiskers on copper substrate is presented, which boosts the surface area by 1000 times compared to non-nanostructured copper substrate. Electrochemically deposited MnO$_2$ on the nanostructured substrate provided a specific capacitance of about 1379 F g$^{-1}$ which is very close to the theoretical value (~1400 F g$^{-1}$) due to this efficient nanostructure design. In addition, a novel method to decorate metal nanoparticles on graphene aerogel, which considerably enhances the electronic conductivity and the corresponding specific capacitance, is demonstrated. Moreover, ferric oxide (Fe$_3$O$_4$) nanorods prepared by a simple hydrothermal method is discussed. Asymmetric devices assembled based on Fe$_3$O$_4$ nanorods and MnO$_2$ nanowhiskers show excellent electrochemical properties. The devices not only display the capability to store energy but also transmit electricity through the inner copper core. These two functions are independent and do
not interfere with each other. Finally, a summary of this dissertation as well as some potential future directions are presented.

Committee: Jayan Thomas (Chair), Sudipta Seal, Lei Zhai, Jiyu Fang, and Kalpathy Sundaram

Graduated Spring 2015
This dissertation investigates the motion of a levitated droplet experimentally and analytically against the Marangoni flow in an immiscible outer fluid at higher speeds than is possible currently. Based on our earlier experiments, when a droplet is released from a height of 1.5 – 4 times its diameter from the liquid surface, it can overcome the impact and stay levitated at the liquid-air interface due to the existence of an air gap between the droplet and the liquid film. In order to explain this behavior of droplet traveling against the counter-current motion, we propose a simple approach: first, the Marangoni convection inside the thin film is considered without the droplet floating on the surface. By using a level-set method and solving the Navier-Stokes equation, the free surface velocity and deformation are calculated. Then, these quantities are used to solve for droplet velocity and drag coefficient simultaneously using a force balance. In order to compare the simulation results, experiments with levitated water droplets on an immiscible carrier liquid, FC-43, were conducted for various temperature gradients, and droplet velocities were measured at different locations using high-speed imaging. The experimental results are in good agreement with the developed theoretical model. For a Reynolds number range of 2-32, it is shown that the drag coefficients are up to 66% higher than those for the fully immersed sphere at the same Reynolds numbers. A correlation is proposed to calculate the drag coefficient of levitated droplets for various temperature drops across the channel.

For the first time, it is shown that it is possible to realize the natural coalescence of droplets through Marangoni effect without any external stimulation, and deliver the coalesced droplet to a certain destination through the use of surface tension gradients. The effects of the various shapes and sizes upon collision are studied. Regions of coalescence and stretching separation of colliding droplets are delineated based on Weber number and impact number. The existence of the transition line between coalescence and stretching separation in this passive mode of transport is similar to what was observed in the literature for forced coalescence at significantly higher Weber numbers. It is also found that a thermocapillary environment
improves the mixing process. In order to illustrate and quantify the mixing phenomenon, the dispensed droplets were made of potassium hydroxide and phenolphthalein which is used as a pH indicator. The experiments show the possibility to reach mixing rates as high as 74% within 120 ms. This study offers new insight to thermo-coalescence and demonstrates how natural coalescence could be used to transport, mix and collect biochemical assays more efficiently. The results of this research can be engineered to enhance the performance of self-cleaning surfaces and micro-total analysis systems (μTAS), where sample transport, filtration, chemical reactions, separation and detection are of great interest.

Committee: Ranganathan Kumar (Chair), Hyoung Jin Cho, Weiwei Deng, Hansen Mansy, and Bhimsen Shivamoggi

Graduated Summer 2015
Biomechanics of Developmental Dysplasia of the Hip: An Engineering Study of Closed Reduction Utilizing the Pavlik Harness for a Range of Subtle to Severe Dislocations in Infants

VICTOR HUAYAMAVE
Mechanical Engineering PhD

Developmental Dysplasia of the Hip (DDH) is an abnormal condition where hip joint dislocation, misalignment, or instability is present in infants. Rates of incidence of DDH in newborn infants have been reported to vary between 1 and 20 per 1000 births, making it the most common congenital malformation of the musculoskeletal system. DDH early detection and treatment is critical to avoid the use of surgical treatment in infants and to prevent future complications such as osteoarthritis in adult life. To this day several non-surgical treatments involving the use of harnesses and braces have been proposed to treat DDH in infants, with the Pavlik harness being the current non-surgical standard used to treat DDH at early stages. Although the Pavlik harness has been proven to be successful treating subtle dislocations, severe dislocations do not always reduce. Until now the use of the harness remains an empirical method, and its effectiveness often depends on physician expertise or trial-error procedures; thus a clear guideline has not been established to determine the best optimal harness configuration to treat both subtle and severe dislocations. The goal of this dissertation is to understand the connection between reductions for subtle and severe dislocations and passive muscle forces and moments generated while the harness is used during treatment.

While the understanding of DDH biomechanics will provide a valuable clinically applicable approach to optimize and increase harness success rate, it is not without its difficulties. This research has created and developed a three-dimensional based on patient-specific geometry of an infant lower limb. The kinematics and dynamics of the lower limb were defined by modeling the hip, femur, tibia, fibula, ankle, foot, and toe bones. The lines of action of five (5) adductor muscles, namely, the Adductor Brevis, Adductor Longus, Adductor Magnus, Pectineus, and Gracilis were identified as mediators of reduction and its mechanical behavior was characterized using a passive response. Four grades (1-4) of dislocation as specified by
the International Hip Dysplasia Institute (IHDI) were considered, and the computer model was computationally manipulated to represent physiological dislocations. To account for proper harness modeling, the femur was restrained to move in an envelope consistent with its constraints.

The model of the infant lower limb has been used to analyze subtle and severe dislocations. Results are consistent with previous studies based on a simplified anatomically-consistent synthetic model and clinical reports of very low success of the Pavlik harness for severe dislocations. Furthermore the findings on this work suggest that for severe dislocations, the use of the harness could be optimized to achieve hyperflexion of the lower limb leading to successful reduction for cases where the harness fails.

This approach provides three main advantages and innovations: 1) the used of patient-specific geometry to elucidate the biomechanics of DDH; 2) the ability to computationally dislocate the model to represent dislocation severity; and 3) the quantification of external forces needed to accomplish reduction for severe dislocations. This study aims to offer a practical solution to effective treatment that draws from engineering expertise and modeling capabilities and also draws upon medical input. The findings of this work will lay the foundation for future optimization of non-surgical methods critical for the treatment of DDH.

Committee: Alain Kassab (Chair), Faissal Moslehy, Eduardo Divo, and Seetha Raghavan

Graduated Spring 2015
Experimental and Numerical Study of Endwall Film Cooling

SRIKRISHNA MAHADEVAN
Mechanical Engineering PhD

This research work investigates the thermal performance of a film-cooled gas turbine endwall under two different mainstream flow conditions. In the first part of the research investigation, the effect of unsteady passing wakes on a film-cooled pitchwise-curved surface (representing an endwall without airfoils) was experimentally studied for heat transfer characteristics on a time-averaged basis. The temperature sensitive paint technique was used to obtain the local temperatures on the test surface. The required heat flux input was provided using foil heaters. Discrete film injection was implemented on the test surface using cylindrical holes with a streamwise inclination angle of 35° and no compound angle relative to the mean approach velocity vector. The passing wakes increased the heat transfer coefficients at both the wake passing frequencies that were experimented. Due to the increasing film cooling jet turbulence and strong jet-mainstream interaction at higher blowing ratios, the heat transfer coefficients were amplified. A combination of film injection and unsteady passing wakes resulted in a maximum pitch-averaged and centerline heat transfer augmentation of \( \approx 28\% \) and 31.7\% relative to the no wake and no film injection case.

The second part of the research study involves an experimental and numerical analysis of secondary flow and coolant film interaction in a high subsonic annular cascade with a maximum isentropic throat Mach number of \( \approx 0.68 \). Endwall (platform) thermal protection is provided using discrete cylindrical holes with a streamwise inclination angle of 30° and no compound angle relative to the mean approach velocity vector. The surface flow visualization on the inner endwall provided the location of the saddle point and the three-dimensional separation lines. Computational predictions showed that the leading-edge horseshoe vortex was confined to approximately 1.5% of the airfoil span for the no film injection case and intensified with low momentum film injection. At the highest blowing ratio, the film cooling jet weakened the horseshoe vortex at the leading-edge plane. The passage vortex was intensified with coolant injection at all blowing ratios. It was seen that increasing average blowing ratio improved the film effectiveness on the endwall. The discharge coefficients calculated for each film cooling
hole indicated significant non-uniformity in the coolant discharge at lower blowing ratios and the strong dependence of discharge coefficients on the mainstream static pressure and the location of three-dimensional separation lines. Near the airfoil suction side, a region of coalesced film cooling jets providing close to uniform film coverage was observed, indicative of the mainstream acceleration and the influence of three-dimensional separation lines.

Committee: Jayanta Kapat (Chair), Shashi Verma (Co-Chair), Subith Vasu Sumathi, Kareem Ahmed, and Bhimsen Shivamoggi

Graduated Fall 2015
Multi-Row Film Cooling Boundary Layers

GREGORY NATSUI
Mechanical Engineering PhD

High fidelity measurements are necessary to validate existing and future turbulence models for the purpose of producing the next generation of more efficient gas turbines. The objective of the present study is to conduct several different measurements of multi-row film cooling arrays in order to better understand the physics involved with injection of coolant through multiple rows of discrete holes into a flat plate turbulent boundary layer.

Adiabatic effectiveness distributions are measured for several multi-row film cooling geometries. The geometries are designed with two different hole spacings and two different hole types to yield four total geometries. One of the four geometries tested for adiabatic effectiveness was selected for flowfield measurements. The wall and flowfield are studied with several testing techniques.

Pressure sensitive paint and discrete gas sampling taps are simultaneously used to measure adiabatic film cooling effectiveness by taking advantage of the heat and mass transfer analogy. All cooling regimes documented by Goldstein [1] for a single row are seen in the multi-row geometries studied. As the blowing ratio increases from 0, the laterally averaged effectiveness increases everywhere, until a point is reached at which upstream rows begin to drop in performance while the downstream rows increase in performance. Finally, a point is reached at which the cooling performance drops everywhere as the blowing ratio is increased.

Detailed boundary layer measurements are obtained with hot wire anemometry. The boundary layer is measured at two upstream locations to characterize the approaching flow and provide boundary conditions for computational predictions. The hot wire technique is then applied to the array at up to 15 streamwise locations to obtain measurements of mean velocity, RMS of the fluctuations and integral length scale, in the presence of film cooling. It was seen that injection thickens the boundary layer significantly. Due to the low turbulence mainstream and jets, turbulence production takes place primarily at regions of high shear between mainflow and coolant or in wakes for the lifted case.
Finally, particle image velocimetry measurements are taken to provide streamwise and wall normal velocity measurements at two streamwise aligned planes in the flow; an array centerline and $d/2$ plane corresponding to the edge of the jets. These measurements show how an increase in blowing ratio decreases turbulence levels throughout the array. The entire structure of the boundary layer changes from shearing at the top to a wall-bounded jet flow as the blowing ratio increases. Despite lower turbulence levels, the high blowing ratio case is seen to perform worse than the low blowing case from the effectiveness measurements. The particle image velocimetry measurements corroborate the hot wire measurements in that the turbulence production occurs where the mainflow and coolant jets meet and interact.

Committee: Jayanta Kapat (Chair), Subith Vasu Sumathi, Jeffrey Kauffman, Seetha Raghavan, and Bhimsen Shivamoggi

Graduated Fall 2015
ZrB$_2$-SiC Based Ultra High Temperature Ceramic Composites: Mechanical Performance and Measurement and Design of Thermal Residual Stresses for Hypersonic Vehicle Applications

RICHARD STADELMANN  
Mechanical Engineering PhD

Ultra-high temperature ceramics (UHTCs), such as ZrB$_2$-based ceramic composites, have been identified as next generation candidate materials for leading edges and nose cones in hypersonic air breathing vehicles. Mechanical performance of ceramic composites play an important role in the ultra-high temperature applications, therefore SiC is added to ZrB$_2$ as a strengthening phase to enhance its mechanical performance. The high melting temperatures of both ZrB$_2$ and SiC, as well as the ability of SiC to form SiO$_2$ refractory oxide layers upon oxidation make ZrB$_2$-SiC ceramics very suitable for aerospace applications.

Thermal residual stresses appearing during processing are unavoidable in sintered ZrB$_2$-SiC ceramic composites. Residual microstresses appear at the microstructural level (intergranular microstresses) or at the crystal structure level (intragranular microstresses). These microstresses are of enormous importance for the failure mechanisms in ZrB$_2$-SiC ceramics, such as ratio of the trans- and intergranular fracture; crack branching or bridging, microcracking, subcritical crack growth and others, as they govern crack propagation–induced energy dissipation and affect the toughness and strength of the ceramic material. Therefore, understanding the evolution of residual stress state in processed ZrB$_2$-SiC ceramic composites and accurate measurements of these stresses are of high priority.

In the present research the ZrB$_2$-17vol%SiC, ZrB$_2$-32vol%SiC, and ZrB$_2$-45vol%SiC ultra-high temperature particulate ceramic composites were sintered using both Hot Pressing (HP) and Spark Plasma Sintering (SPS) techniques. The mechanical performance of the ZrB$_2$-SiC composites was investigated using 3- and 4-point bending techniques for measurements of instantaneous fracture strength and fracture toughness. Resonant Ultrasound Spectroscopy was used for measurement of Young’s, shear, and bulk moduli as well as Poisson’s ratio of the composites. The distribution
of thermal residual stresses and the effect of the applied external load on their re-distribution was studied using micro-Raman spectroscopy. Piezospectroscopic coefficients were determined for all compositions of ZrB$_2$-SiC ceramic under study and their experimentally obtained values were compared with the piezospectroscopic coefficients both published in the literature and calculated using theoretical approach. Finally, the novel ZrB$_2$-IrB$_2$-SiC ceramic composites were also produced using Spark Plasma Sintering (SPS), where IrB$_2$ powder was synthesized using mechanochemical route. It is expected that the IrB$_2$ additive phase might contribute to the improved overall oxidation resistance of ZrB$_2$ based ultra-high temperature ceramic composites.

Committee: Nina Orlovskaya (Chair), Seetha Raghavan, Ranganathan Kumar, and Stephen Kuebler

*Graduated Fall 2015*
Information Propagation Algorithms for Consensus Formation in Decentralized Multi-Agent Systems

CHRISTOPHER HOLLANDER
Modeling and Simulation PhD

Consensus occurs within a multi-agent system when every agent is in agreement about the value of some particular state. For example, the color of an LED, the position or magnitude of a vector, a rendezvous location, the most recent state of data within a database, or the identity of a leader are all states that agents might need to agree on in order to execute their tasking.

The task of the decentralized consensus problem for multi-agent systems is to design an algorithm that enables agents to communicate and exchange information such that, in finite time, agents are able to form a consensus without the use of a centralized control mechanism.

The primary goal of this research is to introduce and provide supporting evidence for Stochastic Local Observation/Gossip (SLOG) algorithms as a new class of solutions to the decentralized consensus problem for multi-agent systems that lack a centralized controller, with the additional constraints that agents act asynchronously, information is discrete, and all consensus options are equally preferable to all agents. Examples of where these constraints might apply include the spread of social norms and conventions in artificial populations, rendezvous among a set of specific locations, and task assignment.

This goal is achieved through a combination of theory and experimentation. Information propagation process and an information propagation algorithm are derived by unifying the general structure of multiple existing solutions to the decentralized consensus problem. They are then used to define two classes of algorithms that spread information across a network and solve the decentralized consensus problem: buffered gossip algorithms and local observation algorithms. Buffered gossip algorithms generalize the behavior of many push-based solutions to the decentralized consensus problem. Local observation algorithms generalize the behavior of many pull-based solutions to the decentralized consensus problem. In the language of object oriented design, buffered gossip algorithms and local observation algorithms
are abstract classes; information propagation processes are interfaces.
SLOG algorithms combine the transmission mechanisms of buffered gossip
algorithms and local observation algorithms into a single “hybrid” algorithm
that is able to push and pull information within the local neighborhood. A
common mathematical framework is constructed and used to determine the
conditions under which each of these algorithms are guaranteed to produce
a consensus, and thus solve the decentralized consensus problem. Finally,
a series of simulation experiments are conducted to study the performance
of SLOG algorithms. These experiments compare the average speed of
consensus formation between buffered gossip algorithms, local observation
algorithms, and SLOG algorithms over four distinct network topologies.

Beyond the introduction of the SLOG algorithm, this research also
contributes to the existing literature on the decentralized consensus problem
by: specifying a theoretical framework that can be used to explore the
consensus behavior of push-based and pull-based information propagation
algorithms; using this framework to define buffered gossip algorithms and
local observation algorithms as generalizations for existing solutions to the
decentralized consensus problem; highlighting the similarities between
consensus algorithms within control theory and opinion dynamics within
computational sociology, and showing how these research areas can be
successfully combined to create new and powerful algorithms; and providing
an empirical comparison between multiple information propagation
algorithms.

Committee: Annie Wu (Chair), Randall Shumaker, Rudolf Wiegand,
Damla Turgut, and Zixia Song

Graduated Spring 2015
A Generic Framework for Multi-Method Modeling and Simulation of Complex Systems Using Discrete Event, System Dynamics and Agent Based Approaches

**KONSTANTINOS MYKONIATIS**

*Modeling and Simulation PhD*

Decisions about Modeling and Simulation (M&S) of Complex Systems (CS) need to be evaluated prior to implementation. Discrete Event (DE), System Dynamics (SD), and Agent Based (AB) are three different M&S approaches widely applied to enhance decision-making of complex systems. However, single type M&S approaches can face serious challenges in representing the overall multidimensional nature of CS and may result in the design of oversimplified models excluding important factors.

Conceptual frameworks are necessary to offer useful guidance for combining and/or integrating different M&S approaches. Although several hybrid M&S frameworks have been described and are currently deployed, there is limited guidance on when, why and how to combine, and/or integrate DE, SD, and AB approaches. The existing hybrid frameworks focus more on how to deal with specific problems rather than to provide a generic way of applicability to various problem situations.

The main aim of this research is to develop a generic framework for Multi-Method Modeling and Simulation of CS, which provides a practical guideline to integrated deployment or combination of DE, SD, and AB M&S methods. The key contributions of this dissertation include: (1) a meta-analysis literature review that identifies criteria and generic types of interaction relationships that are served as a basis for the development of a multi-method modeling and simulation framework; (2) a methodology and a framework that guide the user through the development of multi-method simulation models to solve CS problems; (3) an algorithm that recommends appropriate M&S method(s) based on the user selected criteria for user defined objective(s); (4) the implementation and evaluation of multi method simulation models based on the framework’s recommendation in diverse domains; and (5) the comparison of multi-method simulation models created by following the multi-method modeling and simulation framework.
It is anticipated that this research will inspire and motivate students, researchers, practitioners and decision makers engaged in M&S to become aware of the benefits of the cross-fertilization of the three key M&S methods.

Committee: Waldemar Karwowski (Chair), John Kincaid, Petros Xanthopoulos, and Ilhan Akbas

Graduated Fall 2015
An Integrated Framework for Automated Data Collection and Processing for Discrete Event Simulation Models

CARLOS RODRIGUEZ
Modeling and Simulation PhD

Discrete Events Simulation (DES) is a powerful tool of modeling and analysis used in different disciplines. DES models require data in order to determine the different parameters that drive the simulations. The literature about DES input data management indicates that the preparation of necessary input data is often a highly manual process, which causes inefficiencies, significant time consumption and a negative user experience.

The focus of this research investigation is addressing the manual data collection and processing (MDCAP) problem prevalent in DES projects. This research investigation presents an integrated framework to solve the MDCAP problem by classifying the data needed for DES projects into three generic classes. Such classification permits automating and streamlining the preparation of the data, allowing DES modelers to collect, update, visualize, fit, validate, tally and test data in real-time, by performing intuitive actions. In addition to the proposed theoretical framework, this project introduces an innovative user interface that was programmed based on the ideas of the proposed framework. The interface is called DESI, which stands for Discrete Event Simulation Inputs.

The proposed integrated framework to automate DES input data preparation was evaluated against benchmark measures presented in the literature in order to show its positive impact in DES input data management. This research investigation demonstrates that the proposed framework, instantiated by the DESI interface, addresses current gaps in the field, reduces the time devoted to input data management within DES projects and advances the state-of-the-art in DES input data management automation.

Committee: John Kincaid (Chair), Waldemar Karwowski, Thomas O’Neal, David Kaup, and Mustapha Mouloua

Graduated Summer 2015
The Effect of Videogame Play on Robotic Surgery Skill Acquisition

ALYSSA TANAKA
Modeling and Simulation PhD

Robotic surgery uses innovative technology to transcend a surgeon’s skills when performing complex procedures. Currently, the only FDA approved robotic system is Intuitive’s da Vinci Surgical System. While this system offers many advantages over other minimally invasive techniques, it also introduces a need for specialized training. Virtual reality simulators have emerged as valuable tools for standardized and objective robotic surgery skill training and assessments. In recent years, the idea of using video game technology in surgical education for laparoscopy has also been explored; however few have attempted to make a connection between video game experience and robotic surgical skills. Thus, the current study aims to examine the performance of video gamers in a virtual reality robotic surgery simulator. Furthermore, the video gamers’ performance was compared to that of medical students, expert robotic surgeons, and “laypeople.” The purpose of this study is to examine the hypothesis that video gamers acquire perceptual and psychomotor skills through video game play, similar to those used by robotic surgeons.

Subjects completed a demographic questionnaire and performed three computer-based perceptual tests: a Flanker compatibility task, a subsidizing task, and a Multiple Object Tracking test. Participants then performed two warm-up exercises on the Mimic dV-Trainer to familiarize themselves with the system and eight trials of two core exercises to test their skills. After completing all trials, participants completed a post-questionnaire regarding their experience with the system.

Expert video gamers (n=40), medical students (n=24), laypeople (n=42) and expert robotic surgeons (n=16) were recruited. Medical students and gamers were significantly faster than experts in the Flanker Task. The experts were significantly slower than the all other groups in the subsidizing task. Experts scored significantly higher, were significantly more efficient, and were significantly faster than laypeople, medical students, and gamers in the first trial of Ring & Rail 1 and Suture Sponge. In trial eight of Ring & Rail 1, experts scored significantly higher and were more efficient than laypeople.
Experts were also significantly faster than all other groups. Experts scored significantly higher than laypeople and gamers in trial Suture Sponge. Experts were significantly more efficient and significantly faster than all other groups.

Contrary to prior literature in laparoscopy, this study was unable to validate enhanced abilities of video gamers in a robotic surgery simulator. This study does further demonstrate that the transfer of skills developed through video game play is relevant to the surgical technique. This may be due to the differences of the systems and how the users interact within them. In a society where video games have become an integral past time, it is important to determine the role that video games play in the perceptual and psychomotor development of users. These findings can be generalized to domains outside of medicine that utilize robotic and computer-controlled systems, speaking to the scope of the gamers' abilities and pointing to the capacity within these systems.

Committee: Charles Hughes (Chair), John Kincaid, Juan Cendan, and Roger Smith

Graduated Fall 2015
College of
HEALTH AND
PUBLIC AFFAIRS
The Effects of a Hip Strengthening Program on Novice Runners

ELIZABETH ALFORD
Physical Therapy DPT

Background: The influence hip abductor muscle strengthening plays in prevention of running related injuries and ability to alter running gait biomechanics is largely unknown. This case report assesses the change in muscle strength, incidence of injury, and biomechanical angles during running gait in one novice runner after participation in a 10 week hip abduction strengthening program.

Case Description: One female novice runner participated in a 10 week self-guided hip abduction strengthening program performed in conjunction with a 10 week novice running training program. The hip abduction strengthening program consisted of two phases of 5 exercises. Each exercise was performed in 3 sets of 10 repetitions, 3 times per week. Phase one exercises consisted of Wall squats, Step ups, Quadruped isolated hip extensions, Clamshells, and Single leg bridging. Phase two exercises included Single Leg deadlift, Monster walks with theraband, Pelvic Drops, Sidelying Hip Abductions with theraband, and Sidelying planks. The subject was asked to keep a detailed log of all exercise completions and note any pain or injuries that may have occurred.

Results: The results of the hip strengthening program in concert with the beginners running program showed increases in all motions tested. Increases range from 4.41% gains to 137.21% gains with an average of 49.11% increase. Measured at midstance of the running gait cycle, the subject’s left angle of pelvic obliquity decreased by 2 degrees, right angle of obliquity decreased by 1.5 degrees, and her left and right hip adduction angles improved by 2 and 2.7 degrees, respectively. This individual was able to complete the running program as well as the strengthening program without injury.

Discussion: This case study sought to look at the relationship of a hip strengthening program and how it affects gait mechanics during running and the rate of injury during their training season. There was an increase in strength and no reports of injury during this timeframe, therefore the results
confirm our hypotheses. There were limitations to our study and the program would benefit greatly from being implemented on a greater number of participants with a control group to standardize results.

**Conclusion:** The interventions chosen were successful in increasing global strength in all planes of motions of the hip and decreasing angles of pelvic obliquity and femoral adduction during running gait. This may indicate that by increasing hip musculature strength, dynamic pelvic stability may improve and ultimately reduce risk factors associated with development of running related injuries.

Committee: Carey Rothschild (Chair)

*Graduated Spring 2015*
The Relationship between Measures of Core Strength and Soccer Skill Performance in Competitive Soccer Players

RUDOLF ALVIEDO
Physical Therapy DPT

The relationship between core strength and lower extremity performance has been a popular topic in current literature. This relationship is multifaceted and though it is clear that core strength plays a role in performance, debate remains as to what extent this affects athletic ability and whether that relationship correlates to a specific sport. The aim of this study was to explore the relationship between soccer skill and core strength measures. Subjects included in the study were adults with a minimum six years of competitive soccer experience who were without injury that prohibited them from playing competitive soccer at the time of data collection. Demographic data including age, gender, height, weight and foot dominance was collected. Left foot dominant were excluded from data analysis leaving 50 right foot dominant participants. Soccer-skill performance measures included bilateral kick speed with instep kicks on goal and legal throw-in speed. These components were compared with core measures including front and side planks and lateral medicine ball toss. A Pearson correlation coefficient was utilized to assess relationships of the measures, a significance level of p<0.01 was established. A strong correlation was found between right leg kick speed and right and left side medicine ball throw (p<0.01, r=.472 and r=.444). In addition, forward plank duration was correlated with both right and left average kick speed (p<0.01, r=.385 and r=.450). These findings suggest that core endurance and power, as evidenced by plank times and medicine ball toss, relate to soccer kicking ability in competitive adult soccer players.

Committee: Patrick Pabian (Chair)

Graduated Spring 2015
Factors Affecting Length of Hospital Stay for Patients with Total Knee Replacement or Revision: A Retrospective Cohort Study

STEPHANIE AMES
Physical Therapy DPT

Committee: Jamie Dyson (Chair)
Graduated Spring 2015

Group Fitness Instructors: A Survey on Qualifications and Collaborations with Physical Therapists

KIMBERLY MCGAULEY
Physical Therapy DPT

Committee: Jennifer Tucker (Chair)
Graduated Spring 2015
Short Term Effect of Kettlebell Swings on Lumbopelvic Pressure Pain Thresholds in Healthy Young Adults

JESSICA MILLER
Physical Therapy DPT

The purpose of this study was to investigate the short-term effect of kettlebell swings on lumbopelvic pressure pain thresholds (PPTs) in healthy adults. Sixty participants (61.7% female, age=25.12 years ±2.86, height=170.73 cm ± 9.2, mass=70.49 kg ± 13.32) were randomized into one of two groups. The experimental group performing a warm up followed by eight consecutive 20 second rounds of kettlebell swings with 10 second rest periods. The control group performed the warm-up alone. An evaluator blinded to group assignment, assessed PPTs immediately before and after the intervention using a handheld pressure algometer applied to the right paravertebral (PVM), quadratus lumborum (QL), and piriformis (PF) muscles. No significant between group differences existed at baseline for PPTs (PVM p=.068; QL (p = .134, & PF p=.105). Significant group by time interactions existed for each site following the interventions (PVM, p=.018; QL, p=.004; PF, p=.026). The results of this study suggest kettlebell swings create a reduction in muscle sensitivity to noxious pressure. This may be due to the unique cyclic muscle contraction associated with kettlebell swings which has been proposed to facilitate removal of muscle metabolites however, future studies should evaluate the specific mechanisms. The findings of this study provide a foundation for future studies to examine the use of this type of training in patients with low back pain or post-exercise muscle soreness.

Committee: William Hanney (Chair)

Graduated Spring 2015
Return to Golf Following Rotator Cuff Repair: Current Return-to-Sport Practice Patterns of Physical Therapists

JEFFREY MOORE
Physical Therapy DPT

Introduction: Tears of structures comprising the rotator cuff are seen in golfers, particularly in the lead shoulder. Surgery is often indicated to repair damaged tissue. Following surgery, physical therapy is appropriate for returning patients to normal function and return to golf. Little research exists on protocol regarding return to golf following rotator cuff surgery. This study attempts to identify current rehabilitation trends with regards to this patient population and returning to golf. It is hypothesized that patients will return to putting at 2 ½ months (10 weeks) and return to using a driver at 6 months (24 weeks).

Methods: 1015 physical therapists were surveyed across the United States. Demographic information was collected along with information regarding return to golf for a hypothetical patient status post rotator cuff repair of a medium sized full thickness tear. 71 responses were received. Data was merged with a homogenous prior study in only Florida to produce a total number of responses at 114.

Results: The average return to putting is 9.2 weeks. The average return to using a driver is 23.8 weeks. Significant differences were found between bachelors and masters trained therapists with returning patients to using a full iron swing and a driver. Those using protocol were significantly more conservative than those using clinical judgment with returning patients to all activities except full iron and driver.

Discussion: A contemporary practice pattern was identified as concurrent with the original hypothesis. Between groups there are particular differences in some regards, however there is great evidence of continuity of care.
between physical therapists treating golfers returning to sport following rotator cuff repair.

Committee: Patrick Pabian (Chair)

Graduated Spring 2015
Factors Associated with Training Related Low Back Injury in the Adolescent Competitive Female Gymnast

PAULA SCHULTHIESS
Physical Therapy DPT

Purpose: The purpose of this study is to establish baseline values of physical measures in adolescent female competitive gymnasts and to identify associations between demographic characteristics, training patterns, and physical assessment and gymnastics related low back injury (GRLBI).

Background: USA gymnastics reports an estimated 92,000 participants in competitive gymnasts and an additional 5 million participants recreationally in the United States. Research indicates that the low back accounted for 5.2% to 20.3% of all gymnastics related injuries. Specifically, it has been observed that 8.8% of acute injuries and 18% of overuse injuries involved the middle or lower back. In the general population, a decrease in back muscle endurance has been found to be associated with low back pain. Preseason trunk muscle training by gymnasts has been shown to prevent new episodes of back pain during the following season. Research investigating injury mechanisms in gymnastics revealed that the landing phase of skills caused more injury. Strength and endurance of the spinal stabilizers and hip musculature may aid a gymnast in the prevention of GRLBI.

Methods: Sub-elite competitive female gymnasts were recruited from 3 gymnastics facilities in Florida. Inclusion criteria were female, age 10-17 years, who had competed at any sub-elite level 4-10 as described by USA Gymnastics for at least 3 seasons. Demographic data was collected via a self-administered questionnaire and included: age, height, weight, gymnastics history, training schedule, history of a GRLBI. A GRLBI was defined as “any gymnastics related incident that results in the gymnast missing any portion of a workout or competitive event.” Physical examination data collected included the following: trunk muscle endurance times for flexor, extensor, and side bridge tests; hip muscle strength recorded with a handheld dynamometer for the flexors, extensors, abductors, adductors, internal and external rotators; shoulder flexion and hip rotation measured with a goniometer; trunk range of motion (ROM) measured with two inclinometers in lumbar flexion, lumbar extension, trunk lateral flexion, and thoracic spine...
trunk rotation; and hip flexibility measurements through performance of special tests (Thomas test and Hamstring length test).

**Results:** 32 female gymnasts with average age of 13.09 participated in the study. 43.8% of participants (n=14) reported sustaining a GRLBI during gymnastics training or competition. Compared to sub-elite gymnasts without injury, gymnasts with GRLBI had significant differences (p<0.05) in age (p=.003), onset of menarche (p=.005), left hip internal rotation ROM (p=.017), left hip abduction strength (p=.006), right side bridge endurance (p=.031), left hip abduction/adduction strength difference (p=.007), hip abduction strength ratio (p=.009), hip adduction strength difference (p=.025), left hip flexion/extension strength difference (p=.046), and total hip external rotation strength (p=.048). 57.1% of participants sustaining a GRLBI (n=8) were evaluated by a medical professional and of those, 37.5% (n=3) were then referred to physical therapy.

**Conclusion:** Collectively age, onset of menarche, hip internal rotation flexibility, side bridge endurance, and hip muscle strength ratios both between legs and between agonist-antagonist muscles of the same leg may be associated with gymnastics related low back injuries in sub-elite female gymnasts. Further research, with a larger sample size, to examine a pure causal relationship of these multifaceted variables and gymnastics injuries is warranted.

**Committee:** Carey Rothschild (Chair)

*Graduated Spring 2015*
Physical Characteristics of Instrumentalists as Predictors of Playing-related Injury

AMANDA WILLIAMSON
Physical Therapy DPT

Objective: To determine whether demographics, reported playing patterns, or physical impairments have the greatest influence on predicting if an instrumentalist will suffer from a playing-related injury.

Methods: Subjects were recruited from the instrumental ensembles at the University of Central Florida. Each subject provided demographic information and playing-related history including instrument(s) played and hours played. Each subject then participated in a physical assessment of standing posture, cervical active range of motion, and upper body strength.

Results: Descriptive statistics were run to identify means and frequencies among the variables measured. Overall, 17 subjects participated in the study; demographics included 7 males and 10 females with an average age of approximately 20 years. Participants reported multiple, lengthy practice sessions averaging approximately 112 minutes in length, 8 times per week though few participants reported experiencing a playing-related injury at the time of the study. No statistical significance was identified among individual participants, however when the participants were grouped by instrument class including strings, woodwind, brass, and percussion, statistical differences were identified. These differences were observed in grip strength, deltoid strength, and shoulder rotation strength. In general, woodwinds demonstrated smaller strength measures while percussion and brass demonstrated larger strength measures.

Conclusion: Playing characteristics have been identified for a group of collegiate instrumentalists. Additionally, the presence of differences in strength among the instrument classes has been identified. Despite these differences, further research is needed to adequately assess the relationship between physical characteristics and the risk for sustaining a playing-related musculoskeletal disorder.

Committee: Carey Rothschild (Chair)

Graduated Spring 2015
Organizational Complexity, Emergency Management Plan Adequacy, and Nursing Home Resiliency: A Contingency Perspective

CHERIE BOYCE
Public Affairs PhD

Some social and organizational behavior scientists measure resiliency through anecdotal qualitative research, i.e. personality analyses and stories of life experience. Empirical evidence remains limited for identifying measurable indicators of resiliency. Therefore, a testable contingency model was needed to clarify resiliency factors pertinent to organizational performance. Two essential resiliency factors were: 1) a written plan and 2) affiliation with a disaster network.

This contingency study demonstrated a quantifiable, correlational effect between organizational complexity, disaster plan adequacy and organizational resiliency. The unit of analysis, the skilled nursing facility proved vulnerable, therefore justifying the need for a written emergency management plan and affiliation with a disaster network.

The main purpose of this research was to verify the significance of emergency management plans within a contingency framework of complexity theory, resource dependency, systems theory, and network theory. Distinct sample moments quantified causal relationships between organizational complexity (A), plan adequacy (B) and resiliency (C). Primary and secondary research data were collected from within the context of public health and emergency management sectors within the State of Florida.

The research unit of analysis was the licensed skilled nursing facility specified as a nursing home (NH). Most units were affiliated with healthcare systems, while 19% of the sample were not affiliates. The randomly selected sample population of 200 Florida NH administrators provided primary data through a self-administered survey of randomized questions related to the staff’s comprehension of the facility’s disaster plan and disaster resource management procedures.

Internal validity from social desirability bias was minimized in two ways: 1) by using secondary data retrieved from trusted sources: CMS, MDS 3.0,
and CASPER 2012 and 2) by using survey questions with a 5-point Likert scale to capture staff knowledge, skills and attitudes (KSAs). Distribution of the survey was during the end of hurricane season and the beginning of the annual plan approval cycle (November 4, 2014 until January 19, 2015).

Definitions, calculations, and interpretations of the performance data varied among sources. This lack of clarity created two research challenges: 1) no clear definition of resiliency between healthcare providers and emergency management agencies and 2) no clear definition of organizational complexity. This lack of definition created a problem with utilizing customary performance indicators of organizational behavior within a Donabedian model of medical care: structure (A), process (B), and outcomes (C).

The term resiliency was borrowed from the biological sciences as absorbing, coping and recovering from disruption of routine. In this study, the term resiliency represented disaster response and recovery capabilities for nursing homes that are derived from the complex internal system of patient care. According to Ashby, the state of complexity can be too complicated to quantify and organizational research projects determine component definitions (Ashby, 2007).

In other words, complexity factors are identified by the research methodology. This study analyzed the adequacy of emergency plans designed for nursing home staff, some of the factors were strongly correlated, for example patient comorbidities and level of staffing. For this study, organizational complexity included: acuity indexes, ADL scores, staff hours, staff ratings and occupancy rates. Due to the large quantity of available data, organizational complexity data for this research was reduced into three NH organizational components: patient acuity, workload and administrative strengths.

These factors required three standardized measurement models to improve the accuracy of predicting organizational complexity influence upon plan adequacy and NH resiliency outcomes within the context of a disability centric environment.

The primary finding from this research was the confirmation that disaster plans improve NH resiliency by 16%. The endogenous construct, Plan Adequacy (B) demonstrated a significant resiliency effect of .8 within a scale of absolute 1.
In summary, this empirical study offers strong proof for the contingency theory that NH resiliency is directly influenced by a well-written and exercised emergency plan. Even though the NH population remains vulnerable to emergencies from an organizational perspective, the results confirmed a strong contingency perspective for NH resiliency exists within four disaster plan areas: plan approval status; memorandums of agreement; disaster exercises; and network affiliations.

Committee: Thomas Wan (Chair), Ning Zhang, Reid Oetjen, Fernando Rivera, and Naim Kapucu

Graduated Fall 2015
From American Service to Disservice: 
An Exploration of the Impact of Military 
Experience among an Incarcerated Population 

ERIKA BROOKE

Public Affairs PhD - Criminal Justice

This dissertation research examines the impact of military service among an incarcerated population. It addresses the gaps identified within the prior literature by taking a closer look at the association between service experience and criminal justice outcomes. Specifically, the present study explores whether branch type, combat exposure, age of entrance, service length, and discharge status impact the number of lifetime arrests, current offense type, and institutional misconduct. This research uses data from the U.S. Bureau of Justice Statistics’ 2004 Survey of Inmates in State and Federal Correctional Facilities. Multivariate analyses indicate that different elements of military participation influence criminal and deviant behaviors. Length of service significantly impacted the quantity of lifetime arrests, whereas age of entry, combat experience, and service length were important conditions in offense types. Inmates with military experience were found to be more likely to participate in institutional misconduct. The following service elements were predictors of prison misconduct as well: age of entry, length of service, branch affiliation, and discharge status. The findings in this study have theoretical implications for the use of criminological theory in military service research, and they provide suggestions for future military and criminal justice policy development.

Committee: Jacinta Gau (Chair), Eugene Paoline, Kareem Jordan, and Joseph Vasquez

Graduated Summer 2015
The Effect of the Great Recession on Local Government Policy in Florida

RICHARD LEVEY
Public Affairs PhD - Governance and Policy Research

The length and depth of the Great Recession of 2008 provides an opportunity to examine the policy behavior of local governments unlike any window since the 1930’s post Depression era. Utilizing Peterson’s (1981) *City Limits* typology as a framework for local government policy allows for an evaluation of whether or not the economic downturn caused local governments to change their relative expenditures between policy categories. The *City Limits* typology has been widely used in the literature to explain how expenditures define a local government’s role in economic development. The typology has had limited use in a pre-post natural experimental research design to determine if a local government has ‘shifted’ policy priorities as measured by changes in expenditures among and between policy categories. This research design and the use Peterson’s framework combine for a study that has not yet been conducted under similar conditions.

Most of the existing literature, including the research from the 1980’s, failed to account for inter-state differences that directly affect local government expenditures and policy. Concentrating solely on Florida local governments, this study eliminates the confounding nature of a national study and ensures that the unit of analysis is comparable for research purposes. The study utilizes actual expenditure data for all cities and counties in Florida from FY2006 through FY2011. The research tests for the relationships between changes in policy priorities from pre- to post-recession, and the type of government, form of government, and various socio-economic factors.

The research contributes to a new body of knowledge that is just beginning to emerge in the literature about how local governments respond to periods of extreme fiscal stress. The findings suggest that cities and counties had an inverse response from pre- to post-recession with cities shifting toward developmental expenditures and counties prioritizing allocational spending. Differences were also found between forms of government. In addition, the density of population was found to contribute differently to shifts in expenditures for cities and counties. The study identifies emerging patterns
that can help local governments understand past behavior and better anticipate future economic downturns.

Committee: Lawrence Martin (Chair), Ning Zhang, Wendell Lawther, and Christopher Hawkins

Graduated Fall 2015
State Adolescent Reproductive Health Policies and Their Impact on Teen Pregnancy Outcomes

JENNA TOSH
Public Affairs PhD - Governance and Policy Research

Using multiple regression analysis, this study analyzes the impact of state-level adolescent reproductive health statutes on rates of teenage pregnancy, birth and abortion rates. This study also analyzes the impact that adolescent reproductive health policy outputs have had on teenage pregnancy outcomes between 1992 and 2008, and the disparate impact of policies on minority teens.

While some preventive adolescent reproductive health policies are found to impact teen pregnancy outcomes, most research findings pertain to the impact of abortion policy. Restrictions on minors’ access to confidential prenatal care are associated with reduced rates of teen abortion while restricting access to contraceptive services is associated with increases in teen abortion. Surprisingly, states with more family planning program spending are found to have been less effective in reducing rates of teen pregnancy and births between 1992 and 2008. Abortion restrictions are found to decrease rates of teen abortion and increase rates of teen birth. Mandated parental involvement in minors’ abortions is found to increase rates of teen birth and contributed to a slower rate of decline in teen abortion between 1992 and 2008.

This study indicates disparate impact of both preventive adolescent reproductive health policies and restrictive abortion policies. Restrictive abortion statutes were found to have an exceptionally strong positive effect on rates of Black teen birth, with a moderate impact on Hispanic teen birth and no impact on White teen birth.

Committee: Lawrence Martin (Chair), Thomas Wan, Eileen Abel, and Terri Fine

Graduated Spring 2015
As nearly one third of the world’s population lives in an area that is in some way touched by war, researchers have long been interested in the varied impacts of conflict on civilians. Many indicators, measuring both physical and mental constructs, have been assessed in war-torn populations from around the world, one of which is health-related quality of life (HRQoL). The occupied Palestinian Territories (oPt) are one region in which copious research on health indicators has been undertaken in an effort to understand how long-term conflict manifests itself in noncombatant populations. However, existing studies focus primarily on indicators within the Palestinian population itself that impact HRQoL, and not on the extent to which the presence of the conflict and its consequences disturb physical and mental health outcomes compared to areas without conflict. The purpose of this study is to evaluate the impact of long-term conflict by comparing HRQoL in the oPt and the neighboring country of Jordan, as well as to assess how demographic factors such as socioeconomic status and household size can moderate or aggravate this impact. The potential mediating factors of insecurity and perceived stress will also be assessed. This study found that the presence of conflict was not the most significant predictor of low HRQoL. The mitigating factor of a traditional foundation of mental resilience in Palestinian culture is addressed as a potential explanation for this result. The implications of this study are wide-ranging, particularly in their ability to contribute to healthcare policy recommendations in war-affected areas, and to bolster our understanding of the health status and needs of those living in these areas.

Committee: Lynn Unruh (Chair), Bernardo Ramirez, Albert Xinliang Liu, and Houman Sadri

Graduated Spring 2015
Academic Performance among Homeless Students: Exploring Relationships of Socio-Economic and Demographic Variables

MIRIAM MOORE
Public Affairs PhD - Public Administration

This study examines homeless student academic performance, types of temporary housing used among the homeless, degree of stability or instability for families with school-aged children, child needs for academic success, the importance of parental involvement in a child’s academic growth, and other known factors in relations to child student academic performance, with a focus on grade level and racial differences. A multiple linear regression model is used to test the hypotheses while controlling confounding variables. Statistically significant relationships are reported between race and academic performance, and grade level and academic performance. Practical and policy implications are discussed, as well as limitations of the study and need for future research.

Committee: Thomas Bryer (Chair), Ning Zhang (Co-Chair), Julie Steen, and Haiyan Bai

Graduated Summer 2015
Social Media Responsiveness in the Public Sector: A Study of Social Media Adoption in Three Functional Departments of U.S. Cities

DANIEL SEIGLER

Public Affairs PhD - Public Administration

Public administration research strongly supports the argument for administrator-citizen collaborations and shows that Web 2.0 social media tools have the potential to increase these collaborations. Some public managers have fully embraced the adoption of social media tools to their fullest collaborative potential while other managers have chosen to limit their full collaborative potential. This study examines four environmental influences to determine if they are the cause of the diverse levels of social media adoption among public administrators. A survey of 157 department managers from 261 large cities across the U.S. shows that 82% of the respondents are currently using some form of social media tools to engage citizens. The results show that perceived organizational influences and perceived administrator preconceptions of social media tools are having the greatest impact on the respondents’ decision to adopt social media. Provided that response rate bias is not occurring in this study, there are two possible explanations for the results. One possible explanation is that Web 2.0 social media adoption may be following a similar path as the adoption of earlier forms of Web 1.0 e-government tools. The other possible explanation is that managers may be operating within a rational environment when deciding whether or not to adopt Web 2.0 social media tools.

Committee: Thomas Bryer (Chair), Qian Hu, Dorothy Norris Tirrell, and Terri Fine

Graduated Spring 2015
College of MEDICINE
TIMP-1 Activates a Unique Cardiac Stem Cell Population, CD63\textsuperscript{+ve}/c-kit\textsuperscript{+ve}, Thereby Enhancing Cardiac Differentiation, and Protects the Heart from Adverse Cardiac Remodeling Following Myocardial Infarction

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LATIFA ABDELLI

Biomedical Sciences PhD

We previously demonstrated that embryonic stem (ES) cells over-expressing tissue inhibitor of metalloproteinase-1 (TIMP-1) have increased potential to engraft and differentiate into cardiac myocytes following transplantation into the infarcted heart. However, the ability of TIMP-1 to activate endogenous stem cells and enhance their differentiation into cardiac regenerative cell types is still unknown. We postulate that TIMP-1 may additionally activate a stem cell population that enhances cardiac cell type differentiation in the infarcted myocardium. To prove this hypothesis, we isolated c-kit\textsuperscript{+ve} cells from four weeks old C57BL/6 mice and cultured them in vitro in presence of ES conditioned media (ESCM), ES-TIMP-1-CM or TIMP-1. Our immunostaining data validate the existence of a novel CD63\textsuperscript{+ve}/c-kit\textsuperscript{+ve} cells. When treated with TIMP-1, these cells showed significantly \((p<0.05)\) increased proliferation and differentiation into cardiac myocytes, vascular smooth muscle cells, and endothelial cells. Western blot analysis revealed significantly \((p<0.05)\) increased expression of CD63, phosphorylated and total \(\beta\)-catenin proteins. Furthermore, our RT-PCR data showed increased cardiac gene expression (GATA-4, Mef2C, and Nkx-2.5) when compared to ESCM and control cells. Based on the in vitro findings, we investigated the effect of intramyocardial delivery of TIMP-1 on endogenous CD63\textsuperscript{+ve}/c-kit\textsuperscript{+ve} cells following myocardial infarction (MI). C57BL/6 and TIMP-1 KO mice underwent coronary artery ligation followed by intramyocardial delivery of 20\(\mu\)l of culture media (CC), ESCM, ES-TIMP-1-CM or TIMP-1. Subsequent immunohistochemistry analysis demonstrated the presence of a CD63\textsuperscript{+ve}/c-kit\textsuperscript{+ve} cell population within the peri-infarct area and confirmed intramyocardial delivery of ES-TIMP-1-CM or TIMP-1 significantly \((p<0.05)\) enhanced their proliferation. Percentage of CD63\textsuperscript{+ve}/c-kit\textsuperscript{+ve} cells was significantly \((p<0.05)\) lower in TIMP-1 KO mice compared to C57BL/6 animals. RT-PCR analysis revealed TIMP-1 KO animals expressed significantly less CD63 and TIMP-1 mRNAs compared to C57BL/6 mice. Activated CD63\textsuperscript{+ve}/c-kit\textsuperscript{+ve} cells were
also able to differentiate into major cardiac cell types as previously shown \textit{in vitro}. The differentiation potential of these cells was however higher in C57BL/6 mice compared to TIMP-1 KO mice. We also demonstrate that CD63\textsuperscript{+ve}/c-kit\textsuperscript{+ve} cells differentiation is regulated by CD63/\(\beta\)-catenin pathway \textit{in vivo}. Additionally, we provide evidence that TIMP-1 protects the heart from adverse cardiac remodeling through inhibition of cardiac apoptosis and fibrosis leading to significantly \((p<0.05)\) improved contractile function. Collectively, our data show TIMP-1 plays a dual protective role in the MI heart. It activates a unique stem cell population, CD63\textsuperscript{+ve}/c-kit\textsuperscript{+ve}, which proliferates and differentiates into functional myocytes, smooth muscle cells and endothelial cells mediated through CD63/\(\beta\)-catenin pathway. TIMP-1 also protects the heart from adverse cardiac remodeling. Increased cardiac regeneration and inhibition of adverse cardiac remodeling consequently lead to restored cardiac function.

Committee: Dinender Singla (Chair), Zixi Cheng, Sampath Parthasarathy, and Mollie Jewett

\textit{Graduated Summer 2015}
The CT20 Peptide as an Agent for Cancer Treatment

RANIA BASSIOUNI
Biomedical Sciences PhD

Due to cancer recurrence and the development of drug resistance, metastatic breast cancer is a leading cause of death in women. In the search for a new therapeutic to treat metastatic disease, we discovered CT20p, an amphiphatic peptide based on the C-terminus of Bax. Due to inherent properties of its sequence and similarity to antimicrobial peptides, CT20p is a promising cytotoxic agent whose activity is distinct from the parent protein (e.g. does not cause apoptosis). CT20p is not membrane permeable but can be introduced to cells using polymeric nanoparticles, a method that promotes efficient delivery of the peptide into the intracellular environment.

We demonstrated that CT20p was cytotoxic using triple negative breast cancer (TNBC) cell lines, primary breast tumor tissue, and breast tumor murine xenografts. Importantly, normal breast epithelial cells and normal primary breast cells were resistant to the lethal effects of the peptide. Examination of multiple cellular processes showed that CT20p causes cell death by promoting cytoskeletal disruption, cell detachment, and loss of substrate-mediated survival signals.

In order to identify the intracellular target of CT20p, we performed pull-down experiments using a biotinylated peptide and found that CT20p binds directly to a type II chaperonin called chaperonin containing T-complex (CCT), which is essential for the folding of actin and tubulin into their native forms. The resulting effect of CT20p upon the cytoskeleton of cancer cells is disruption of vital cellular processes such as migration and adhesion. CCT gene expression and protein levels were examined across several breast cancer cell lines, and we found that susceptibility to CT20p correlated with higher CCT levels. Using human cancer tissue microarrays, we determined that CCT was present in significantly higher amounts in tumor tissues compared to normal tissues and that expression often increased with advanced cancer stage. These results indicate that CCT is a promising therapeutic target for the treatment of metastatic breast cancer and suggest that the use of cancer-targeted nanoparticles loaded with CT20p is a novel
and effective therapeutic strategy for cancers, such as TNBC, that recur and are refractory to current treatments.

Committee: Annette Khaled (Chair), Deborah Altomare, Jihe Zhao, and Alvaro Estevez

Graduated Summer 2015
Overexpression of Human Cu/Zn Superoxide Dismutase in Mice: A Model to Study the Effect of Increased Superoxide Scavenging on the Autonomic Control of the Heart

JEFFREY HATCHER
Biomedical Sciences PhD

Dysregulation of the autonomic cardiovascular control is a complication of diseases including diabetes, hypertension, sleep apnea, and aging. A common factor in these conditions is an increase in reactive oxygen species (ROS) in neural, cardiac, and endothelial tissues. Cu/Zn superoxide dismutase (SOD1) is an intracellular anti-oxidant enzyme that catalyzes dismutation of the superoxide anion (O$_2^-$) to hydrogen peroxide (H$_2$O$_2$). Expression and function of this enzyme are diminished in pathologies that impair cardiovascular autonomic control. This study employed mice overexpressing a transgene for human SOD1 (hSOD1) to determine if its overexpression would alter autonomic regulation of BP, HR, and BRS in healthy animals, and if this animal line (C57B6SJL-Tg (SOD1)2 Gur/J) could be used in future studies to determine if hSOD1 overexpression can preserve cardiac autonomic function in disease models. To accomplish this aim, using anesthetized SOD1 and C57 (control) mice, we recorded HR, and aortic depressor nerve (ADN) activity changes in response to pharmacologically-induced BP changes in order to measure baroreflex and baroreceptor sensitivity, respectively. In order to identify any alterations in central, efferent, and cardiac components of the baroreflex arc, we electrically stimulated the left ADN and left cervical vagus and compared the reductions in BP and HR between the C57 and SOD1 mice. Time- and frequency-domain analysis of heart rate variability (HRV) was performed using pulse pressure recordings prior to pharmacologic or surgical procedures. We found that hSOD1 overexpression in the SOD1 mouse line, in comparison to C57 controls did not significantly affect resting HR (C57: 558 ± 8 vs. SOD1:553 ± 13 beats-per-minute) or blood pressure (C57: 88.8 ± 2.9 vs. SOD1: 85.8 ± 2.1 mmHg). hSOD1 overexpression did not affect the decrease in average mean arterial pressure (MAP) following injection of sodium nitroprusside (SNP) (C57: 38.7 ± 1.4 vs. SOD1: 39.5 ± 1.3 mmHg) or increase in average MAP (C57: 135.8 ± 3.1 vs. SOD1: 136.6 ± 3.5 mmHg) following injection of phenylephrine (PE). BRS, as measured by the averaged regression lines for ΔHR/ΔMAP for the SNP-induced tachycardic baroreflex (C57: 0.57 ±
0.06 bpm/mmHg, SOD1: 0.61 ± 0.08 bpm/mmHg)) and the PE-induced bradycardic baroreflex (C57: -2.9 ± 0.57 bpm/mmHg, SOD1: -4.3 ± 0.84 bpm/mmHg) are not significantly different between C57 and SOD1. Baroreceptor activation showed a significant increase in gain (C57: 5.4 ± 0.3 vs. SOD1: 7.4 ± 0.5 %/mmHg, P < 0.01) in the SOD1 transgenic mice. Heart rate depression in response to electrical stimulation of the left ADN and cervical vagus was comparable between C57 and SOD1, though MAP reduction in response to ADN stimulation is slightly, but significantly increased at 50 Hz in SOD1 animals. Time-domain analysis of HRV did not reveal any significant difference in beat-to-beat variability between SOD1 and C57 (SDNN: C57: 2.78 ± 0.20, SOD1: 2.89 ± 0.27), although frequency-domain analysis uncovered a significant reduction in the low-frequency power component of the HRV power spectral distribution (C57: 1.19 ± 0.11, SOD1: 0.35 ± 0.06, P < 0.001). This study shows that although hSOD1 overexpression does not affect overall baroreflex function, it does potentiate baroreceptor sensitivity and brain stem control of arterial pressure, and reduces low-frequency beat-to-beat variations in HR, without affecting total HRV.

Committee: Zixi Cheng (Chair), Ella Bossy-Wetzel, Cristina Fernandez-Valle, and Kevin Belfield

Graduated Summer 2015
A High-content Multiplexed Screening Platform for the Evaluation and Manipulation of Force and Fatigue of Adult Derived Skeletal Muscle Myotubes in Defined Serum-free Medium

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CHRISTOPHER MCALEER  
Biomedical Sciences PhD

The overall focus of this project has two parts: First, was to develop a protocol utilizing serum-free media formulations and defined plating and culture techniques to create functional *in vitro* myotubes derived from adult skeletal muscle satellite cells. The second was to manipulate the inherent muscle parameters such as force output and fatigue of these myotubes by employing exercise regimes or by small molecule application.

The importance of serum-free medium use for *in vitro* cultures is becoming increasingly important in creating functional systems that can be validated for drug testing by the Food and Drug Administration (FDA). Also, the study of age related diseases as well as the potential for “personalized medicine” relies on the proliferation and maturation of satellite cells from adult derived tissue. For that purpose, a serum-free medium and culture system was designed to create mature striated myotubes in culture on a defined non-biological substrate N-1[3-trimethoxysilyl propyl] diethylenetriamine (DETA). These myotubes were evaluated by morphology, muscle specific protein expression, and by muscle functionality. After the thorough characterization of the resultant myotubes the functional output of the muscle was altered utilizing chemical means (creatine supplementation and PGC-1α agonists), chronic long term stimulation, and the use of PGC-1α deficient tissue.

In this thesis presentation the utility of the newly developed medium formulation to create myotubes from a variety of adult derived muscle sources will be shown. A protocol in which to exercise skeletal muscle *in vitro* to alter endurance was developed and employed to manipulate skeletal muscle. Finally, small molecules were tested to validate this system for drug study use. This engineered system has the potential for high-throughput
screening of drugs for efficacy and drug toxicity studies as well as general biological studies on muscle fatigue.

Committee: James Hickman (Chair), Steven Ebert, Zixi Cheng, and Stephen Lambert

Graduated Spring 2015
The Role of a Highly Conserved Eubacterial Ribosomal Protein in Translation Quality Control

ANUSHA NAGANATHAN
Biomedical Sciences PhD

The process of decoding is the most crucial determinant of the quality of protein synthesis. Ribosomal protein L9 was first implicated in decoding fidelity when a mutant version of L9 was found to increase the translation of a T4 phage gene. Later studies confirmed that the absence of L9 leads to increased translational bypassing, frameshifting, and stop codon readthrough. L9 is part of the large subunit of the prokaryotic ribosome and is located more than 90 Å from the site of decoding, making it difficult to envision how it might affect decoding and reading frame maintenance. Twenty years after the identification of L9's putative function, there is no mechanism for how a remotely located L9 improves translation fidelity. This mystery makes our picture of translation incomplete. Despite the high conservation of L9 in eubacteria, E. coli lacking L9 does not exhibit any obvious growth defects. Thus, the evolutionary advantage conferred by L9 in bacteria is masked under laboratory conditions. In order to uncover unique L9-dependent conditions, a library of E. coli mutants was screened to isolate those that rely on L9 for fitness. Interestingly, factors found to be synergistic with L9 had no known role in fidelity. Six independent mutants were isolated, each exhibiting a severe growth defect that is partially suppressed in the presence of L9. One class of L9-dependent mutations was present in an essential ribosome biogenesis factor, Der. Der's established function is in the maturation of the large ribosomal subunit. The identified mutations severely impaired the GTPase activity of Der. Interestingly, L9 did not directly compensate for the defective GTPase activity of mutant Der. The second class of L9-dependent mutations was present in EpmA and EpmB, factors required to post-translationally modify elongation factor, EF-P. EF-P's established function is in the translation of poly-proline containing proteins. EF-P deficient cells were nearly inviable in the absence of L9; however, L9 did not directly influence poly-proline translation. Therefore, in each case, L9 improved cell health without altering the activity of either Der or EF-P. Remarkably, the der mutants required only the N domain of L9, whereas the absence of active EF-P required full-length, wild-type L9 for growth complementation. Thus, each mutant class needed a different
aspect of L9's unique architecture. In cells lacking either active EF-P or Der, there was a severe deficiency of 70S ribosomes and the indication of small subunit maturation defects, both of which worsened upon L9 depletion. These results strongly suggest that L9 plays a role in improving ribosome quality and abundance under certain conditions. Overall, the genetic screen lead to the discovery that bacteria need L9 when either of two important translation factors (Der or EF-P) is inactivated. This work has characterized the physiological requirement for L9 in each case and offers a new insight into L9's assigned role in translation fidelity.

Committee: Sean Moore (Chair), Alexander Cole, Kenneth Teter, Herve Roy, and Eda Koculi

Graduated Spring 2015
Proteomic Analysis Delineates the Signaling Networks of *Plasmodium falciparum*

BRITTANY PEASE  
Biomedical Sciences PhD

Malaria is a life-threatening disease caused by *Plasmodium* parasites that are spread through the bites of infected mosquito vectors. It is a worldwide pandemic that threatens 3.4 billion people annually. Currently, there are only a few validated *Plasmodium* drug targets, while drug resistance continues to rise. This marks the urgency for the development of novel parasite-specific therapeutics. *Plasmodium falciparum* diverges from the paradigm of the eukaryotic cell cycle by undergoing multiple rounds of DNA replication and nuclear division without cytokinesis. A better understanding of the molecular switches that coordinate the progression of the parasite through the intraerythrocytic developmental stages will be of fundamental importance for the design of rational intervention strategies.

To achieve this goal, we performed an isobaric tag-based approach for a system-wide quantitative analysis of protein expression and site-specific phosphorylation events of the *Plasmodium* asexual developmental cycle in the red blood cells. This study identified 2,767 proteins, 1,337 phosphoproteins, and 6,293 phosphorylation sites. Approximately 34% of identified proteins and 75% of phosphorylation sites exhibit changes in abundance as the intraerythrocytic cycle progresses.

Because the links between *Plasmodium* protein kinases as key cell cycle regulators to cellular events are largely unknown, it is of importance to define their cognate physiological substrates. To test the hypothesis that genetic screening would be a useful approach for discovery of candidate substrates of a protein kinase, we used the orphan kinase PfPK7 as a model. Our comparison of the phosphoproteome profiles between the wild-type 3D7 and PfPK7- parasites identified 146 proteins with 239 phosphorylation sites exhibiting decreased phosphorylation in the absence of PfPK7 at the developmental stages where nuclear division and merozoite formation occur. Further analysis of the decreased phosphorylated events revealed three motifs that are enriched among phosphorylated sites in proteins that are down regulated. *In vitro* kinase assays were done to validate the potential
substrates of PfPK7 and to elucidate the signaling events that are regulated by PfPK7.

In parallel to our experimental analysis, we used a computational approach for substrate prediction from our phosphoproteome dataset. This analysis identified 43 distinct phosphorylation motifs and a range of proline-directed potential MAPK/CDK substrates. To identify substrates/interactors of *Plasmodium* CDK-like kinases, we also used HA-tagged CDK-like kinases, PfPK6 and Pfmrk lines. Co-immunoprecipitation of the HA-tagged PfPK6 and Pfmrk baits, followed by mass spectrometric analyses, identified the components of the protein interaction complexes of these kinases. Our analyses of HA-PfPK6 and HA-Pfmrk immunoprecipitates identified 15 and 21 proteins in the interaction complex, respectively. The ability of recombinant PfPK6 and Pfmrk to interact and/or utilize any of the proteins identified in the interaction complex as substrates was verified through *in vitro* kinase assays and pull-down analysis.

This study is the most comprehensive definition of the constitutive and regulated expression of the *Plasmodium* proteome during the intraerythrocytic developmental cycle, and offered an insight into the dynamics of phosphorylation during the asexual cycle progression [1]. In summary, this study has 1) defined the constitutive and regulated expression of the *Plasmodium* proteome during its asexual life cycle, 2) demonstrated that fluctuation and reversible phosphorylation is important for the regulation of *P. falciparum*’s unique cell cycle, 3) provided the foundation for quantitative phosphoproteomic analysis of kinase negative mutants to understand their function, 4) provided a major step towards defining kinase-substrate pairs operative within parasite’s signaling networks, and 5) generated a preliminary interactome for PfPK6.

Committee: Debopam Chakrabarti (Chair), Annette Khaled, Mollie Jewett, Ratna Chakrabarti, and Alexander Cole

*Graduated Summer 2015*
College of
NURSING
Impact of Interruption Frequency on Nurses’ Performance, Satisfaction, and Cognition During Patient-Controlled Analgesia Use in the Simulated Setting

KRISTI CAMPOE
Nursing PhD

Interruption during medication administration is a significant patient safety concern within health care, especially during the administration of high risk medications in nursing practice. Specifically, patient-controlled analgesia (PCA) devices are frequently associated with adverse events and have a four-fold increased risk of patient injury compared to non-PCA related adverse events. While the nature and frequency of interruptions have been established for nurses’ medication processes, the impact of interruption frequency on nurses’ PCA interaction has not been fully described or measured. The purpose of this study was two-fold: (a) to quantify the impact of interruption frequency on registered nurses’ performance, satisfaction, and subjective workload during PCA interaction, and (b) determine nurses’ perceptions of the impact of interruption frequency.

This study employed a mixed-method design. First, an experimental repeated measures design was used to quantify the impact of interruption frequency. Nine registered nurses (RN) were recruited from Florida hospitals. The RNs completed PCA programming tasks in a simulated laboratory nursing environment for each of four conditions where interruption frequency was pre-determined. Established human factors usability measures were completed for each of the four test conditions. RN performance was video-recorded with time-stamp then analyzed for performance measures of efficiency (total task time) and effectiveness (accuracy). RNs completed a user satisfaction survey and subjective workload assessment (NASA-TLX). The research questions were answered using repeated measures analysis of variance with (RM-ANOVA), McNamar’s test, and Friedman’s test. After each experiment, semi-structured interviews were used to collect data that were analyzed using inductive qualitative content analysis to determine nurses’ perceptions of the impact of interruption frequency.

The sample of RNs (n=9) was female (100%) working full-time in the medical-surgical setting. Total time to complete tasks (seconds) ranged...
from 189.00 to 419.00 ($M=292.11$, SD=73.25). For accuracy, total number of errors for participants ranged from 0 to 6 ($M=1.56$, SD=94.71). Five (56%) participants reported a low impact of interruption frequency on their satisfaction. Subjective workload scores for the NASA-TLX (raw) for condition A ($M=23$, SD=10.87) and condition B ($M=26.00$, SD=11.14) ranged from 12.00 to 47.00; the range was highest for condition C ($M=31.56$, SD 22.31) at 12.00 to 78.00. The research questions were answered using repeated measures analysis of variance with (RM-ANOVA), McNamar’s test, and Friedman’s test. Results of the RM-ANOVA were significant for the main effect of interruption frequency on efficiency $F(3,24)=9.592$, $p = .000$. McNemar’s test did not show significance for the impact of interruption frequency on effectiveness (accuracy). Friedman test showed participant satisfaction was significantly impacted by interruption frequency ($x^2=9.47$, $df=3$, $p=0.024$). Friedman test showed no significance for the main effect of interruption frequency on subjective workload scores by condition type ($x^2=1.88$, $df=3$, $p=0.599$). Results of the qualitative content analysis revealed two main categories to describe nurses’ perception of interruption frequency: the nature of interruptions and nurses’ reaction to the interrupted work environment.

The results suggested that interruption frequency significantly affected efficiency (task completion time) and satisfaction for participants but not participant effectiveness (accuracy) or subjective workload scores. The high error rate during PCA programming tasks indicated the need to evaluate the conditions in which nurses complete PCA programming as each error is potential risk of patient harm or injury. Interruption frequency may lead to time pressure that negatively impacts total task time and accuracy. Nurses’ described the impact of interruption frequency as having a negative impact on the work environment and subsequently implement compensating strategies to counterbalance the impact of interruption in the workplace. Nurses perceive that patient safety is negatively impacted by frequent interruption and nurses experience negative intrapersonal consequences as a results of frequent interruption, that have the potential to negatively impact performance, satisfaction, and subjective workload. Additional study is needed to better understand the impact of interruption frequency on nurses’ performance effectiveness (accuracy) and subjective workload.

Committee: Steven Talbert (Chair), Mary Lou Sole, Diane Andrews, and Florian Jentsch

Graduated Summer 2015
Heart failure is a chronic, progressive syndrome that affects more than five million Americans. It is the most common hospital diagnosis for Medicare recipients, and the most frequent cause for readmissions, with an estimated annual cost of $12 billion. In addition to the economic impact, heart failure exacerbations requiring hospitalizations result in worsening of the condition and quality of life for the patient, and is an independent risk factor for increased mortality. Self-care is a key component of managing this syndrome and approximately half of all readmissions are considered the result of inadequate self-care. Perceived social support has been associated with better self-care and reduced readmissions, but studies often used a proxy for social support. Heart failure self-care is included in guidelines from all major cardiology groups, yet only one study definitively showed evidence that better self-care is related to improved clinical outcomes. The purposes of this study were to determine if hospitalized heart failure patients had deficiencies in self-care and perceived social support when compared with a sample of community-dwelling heart failure patients, define the relationship of perceived social support to self-care, and establish the association of self-care confidence to self-care maintenance and self-care management.

Patients who met inclusion criteria and were hospitalized with an exacerbation of heart failure were approached after medical stabilization. Immediately following informed consent, patients were screened for ability to perform their own activities of daily living and given the Blessed Orientation-Memory-Concentration (BOMC) test to assure cognition sufficient for informed consent. Those that passed the BOMC then participated in the study. The Medical Outcomes Study - Social Support emotional/informational subscale (MOS-SS) and the three Self-Care of Heart Failure Index (SCHFI) subscales were administered. Demographic and clinical data were collected from the electronic medical record and the participant. A weighted co-morbidity score was calculated from the Charlson Co-morbidity Index (CCI). Two-sample $t$ tests with unequal variances and multiple regression were used to analyze the data. Control variables for the regression models included age, gender, CCI score, number of heart failure
admissions in the past six months, whether or not living with another, and education level. Results were compared with a study of community-dwelling heart failure patients in North Carolina that was published by Cené et al. in 2013.

A convenience sample of 121 hospitalized heart failure patients at four Central Florida hospitals participated in the study; 25% of consented patients were not included because their BOMC cognition scores were outside of the parameter. The mean age of participants was 71.24 years. Gender and type of heart failure were evenly distributed. Over 30% of the sample was comprised of Black/African American patients and only 9% of the sample was Hispanic ethnicity, which was primarily due to the study’s language criteria. The number of heart failure admissions in the prior six months ranged from one to 12, with a median of two; 47% of participants had only one admission. Cronbach’s alpha was calculated for each subscale and determined to be within the range of other studies.

The MOS-SS score was significantly lower than in Cené’s study. Self-care maintenance was also significantly lower than the community-dwelling study participants, while both self-care management and self-care confidence mean scores were essentially the same in both studies. However, when comparing the percentage of participants who scored at least a 70 on each scale, which is considered the minimum score for adequate self-care, participants in this study were lower on self-care maintenance, similar on self-care management, and higher on self-care confidence when compared with Cené’s community-dwelling patients. The only significant relationship with perceived social support in regression models was with self-care confidence. Other significant relationships in the regression models included: the number of heart failure hospitalizations in the previous six months and education with self-care maintenance, and education and age with self-care management. Self-care confidence was statistically significantly associated with both self-care maintenance and self-care management. Age, number of heart failure admissions in the past six months, and education were also related to self-care maintenance in the regression model.

In summary, perceived social support was only significantly related to self-care confidence, and self-care confidence was significantly associated with both self-care maintenance and self-care management in this sample of hospitalized heart failure patients. The percentage of patients with adequate self-care confidence scores was higher than scores reported for community-
dwelling patients. In addition, 25% of consented patients demonstrated cognitive impairment.

Committee: Mary Sole (Chair), Norma Conner, Donna Neff, and Richard Hofler

Graduated Fall 2015
The Impact of Relational Coordination and the Nurse on Patient Outcomes

FANYA DEJESUS
Nursing PhD

Healthcare quality remains a significant issue due to fragmentation of care in our complex U.S. healthcare systems. While coordination of care is foundational to healthcare quality as well as identified as a National Priority, fragmentation and uncoordinated care continues to afflict our systems. The purpose of this study was to explore the relationship between relational coordination and adverse nurse sensitive patient outcomes, namely hospital acquired pressure ulcers, patient falls with injury, catheter-associated urinary tract infection, and central line-associated bloodstream infection. A retrospective correlational survey design using cross sectional data was used to conduct this quantitative study. An electronic relational coordination survey was sent to 1124 eligible registered nurses from 43 nursing units within a 5-hospital magnet-designated healthcare system to gather their perception of the strength of relationship and communication ties of their work team. The nurse practice environment as well as nurse education were control variables. With 406 nurses who completed the survey (36% response rate), findings revealed that the stronger relational coordination ties are amongst the healthcare team, the lower the rate of adverse nurse sensitive patient outcomes as indicated by their inverse relationship. (rs=-.31, p=.050). In a Negative Binomial Regression model, relational coordination was a significant predictor (β=-1.890, p=.034) of nurse sensitive patient outcomes whereas nurse education level (p=.859) and nurse practice environment (p=.230) were not. Data affirms that relational coordination, a relationship and communication intensive form of coordination does impact patient outcomes. This research provides significant information to health care leaders and institutions with goals of improving patient care outcomes through enhancement of coordination of care and optimization of healthcare teams.

Committee: Diane Andrews (Chair), Mary Lou Sole, Donna Neff, Xin Yan, and Lynn Unruh

Graduated Fall 2015
Unplanned hospital admissions (UHA) in older adult populations are a recurring problem in older adults with cancer. Older adults comprise approximately 60% of cancer diagnoses and receive the majority of cancer treatment. However, little is known about why older adults under treatment for cancer experience a high number of unplanned hospital admissions. A review of the literature provided few study findings and a gap in the current knowledge was identified regarding the factors associated with unplanned hospital admissions in older adults under treatment for cancer. A conceptual framework based on the literature and this researcher’s clinical experiences guided this study. The purpose of this study was to explore the factors related to unplanned hospital admissions and determine if one or more factors are predictive of unplanned hospital admissions of older adults with cancer.

A convenience sample of 129 dyads of older adults with cancer and their family caregivers were approached and enrolled in the adult oncology outpatient infusion centers and inpatient units within a community cancer center in central Florida. Patient demographic and clinical data were obtained through a retrospective medical record review. Family caregiver demographic and side effect knowledge data was collected prospectively during interviews with family caregivers using a newly developed tool, Nurse Assessment of Family Caregiver Knowledge and Action Tool (NAFCKAT). The NAFCKAT contains 11 items to determine baseline knowledge about side effects and plan for managing side effects. A fever subsection consists of 4 knowledge and 2 action questions and a dehydration subsection consists of 2 knowledge and 2 action questions. Preliminary research was conducted to determine reliability and validity of the NAFCKAT. Excellent inter-reliability was found for the tool and preliminary support for validity was determined for the fever subscale.

Descriptive statistics and logistic regression analyses were used to evaluate data collected from patient medical records and NAFCKAT scores. Study findings revealed that unplanned hospital admissions were more likely to
occur when older adults had the presence of impaired function prior to treatment initiation and/or experienced side effects of infection/fever and vomiting/diarrhea during treatment. The presence of impaired function and family caregiver support (knowledge and availability) did not moderate the relationship between side effects and unplanned hospital admissions. Findings suggest that the presence of impaired function and side effects of infection and fever, and vomiting and diarrhea, predict unplanned hospital admissions in older adults during the active cancer treatment phase.

Nurses should advocate for and conduct targeted assessments to identify the presence of functional impairments prior to cancer treatment initiation. In addition, nurses should actively monitor for the presence of cancer treatment-related side effects during the treatment phase of the cancer trajectory. Information gained from these assessments will assist nurses to provide practical and tailored strategies to support older adults and their family caregivers during cancer treatment and reduce the risk for unplanned hospital admissions.

Committee: Victoria Loerzel (Chair), Mary Lou Sole, Denise Gammonley, and Anne Norris

Graduated Spring 2015
Helping Mothers Defend Their Decision to Breastfeed

KANDIS NATOLI
Nursing PhD

The United States has established breastfeeding as an important health indicator within the Healthy People agenda. Healthy People target goals for breastfeeding initiation, duration, and exclusivity remain unmet. The US Surgeon General’s Office reports that lack of knowledge and widespread misinformation about breastfeeding are barriers to meeting Healthy People goals. Breastfeeding mothers are vulnerable to messages that cast doubt on their ability to breastfeed. Very little research has examined specific approaches to help people resist negative messages about health beliefs and behaviors. The objective of this quasi-experimental study was to test an intervention designed to help mothers defend their breastfeeding decisions and resist influences that attempted to persuade them to give formula to their babies. Women attending prenatal breastfeeding classes were recruited and assigned to comparison and intervention groups. The intervention was a board game based on McGuire’s inoculation theory of resistance to influence. Controlling for intention to breastfeed, intervention and comparison groups were examined for differences in maternal self-efficacy to resist persuasion to give formula and breastfeeding rates for initiation, duration, and exclusivity. Data analyses consisted of analysis of covariance and logistic regression. There was no significant difference between comparison and intervention groups, both groups had high self-efficacy to resist giving formula to their babies; nor were there significant differences regarding breastfeeding initiation, duration and exclusivity. The lack of significant differences may have been influenced by ceiling effects in all of the breastfeeding variables, possibly due to the high socioeconomic level of the sample. The intervention may have worked better in women who were more prone to dissuasive influence, such as those with lower education.

Committee: Karen Aroian (Chair), Maureen Covelli, Susan Quelly, Nizam Uddin, and Ann Miller

Graduated Fall 2015
Nurse Managers, Work Environment Factors and Workplace Bullying

JOY PARCHMENT  
Nursing PhD

The purpose of this dissertation is to explore relationships between authentic leadership style, global social power, job demand, job control, and workplace bullying of nurse managers in acute care settings across the United States.

Over 30 years of workplace bullying research exists. Consequences are linked to intent to leave, turnover, and harmful emotional and physical effects. Published studies identifying nurse managers as targets of workplace bullying and work environment factors that contribute to nurse managers being recipients of workplace bullying either, downward from their leaders, horizontally from their nurse manager peers, and upwards from their clinical nurses were not identified.

A descriptive, cross-sectional design using an online survey was utilized. Descriptive, inferential, and multivariate analyses were used to identify relationships and the likelihood of workplace bullying occurring. Thirty-five percent (n = 80) of nurse managers reported being a target of workplace bullying. Managers sustained occasional (56%, n = 45) and severe (44%, n = 35) levels of workplace bullying, 65% (n = 43) identified their executive nurse leader as the predominate perpetrator. Authentic leadership, job demand, job control correlated significantly (p < .01) with workplace bullying and job demand demonstrated the strongest likelihood (OR = 3.9) for predicting workplace bullying. Nurse Managers are four times more likely to be a recipient of workplace bullying when their job responsibilities are classified as demanding.

This study expanded the science and demonstrated that nurse managers, the backbone of organizations, are recipients of workplace bullying emanating predominately from executive nurse leaders, but also from clinical nurses and their nurse manager peers. Given the harmful consequences of workplace bullying, as ‘guardians’ of and ‘advocates’ for their teams, executive nursing
leaders, have an ethical and operational responsibility to ensure nurse managers are able to practice in a safe environment.

Committee: Diane Andrews (Chair), Donna Neff, Norma Conner, Xin Yan, and Carol Saunders

Graduated Fall 2015
A Faith-Based Primary Diabetes Prevention Intervention for At-Risk Puerto Rican Adults: A Feasibility Study

SYLVIA TORRES-THOMAS
Nursing PhD

Diabetes is a serious health threat that disproportionately affects Hispanics of Puerto Rican heritage. Current evidence supports diabetes prevention programs to change health behaviors in people who are at risk and thus prevent the development of type 2 diabetes. However, few interventions exist for Hispanics, and even fewer have been designed for Puerto Rican adults. A literature review of community-based diabetes prevention programs involving at-risk Hispanics was conducted using a cultural sensitivity framework to determine the state of the science and identify gaps in knowledge regarding diabetes prevention for Puerto Ricans. An integrated theoretical framework was developed using constructs from the extended parallel process model (perceived severity and susceptibility) and social cognitive theory (self-efficacy) to design program components aimed to educate and motivate positive dietary behavior change in Puerto Rican adults. The two key components were a diabetes health threat message and dietary skill building exercises that incorporated spirituality and relevant faith practices, and were culturally-tailored for Puerto Ricans.

A pretest-posttest, concurrent mixed methods design was used to test the impact and evaluate feasibility of a diabetes health threat message and skill-building exercises in a sample of Puerto Rican adults. A total of 24 participants enrolled in the study and attended six-weekly meetings that included baseline data collection, a health threat message, dietary skill building exercises, focus group interviews, posttest data collection, and an end-of-study potluck gathering. All of the study participants were Puerto Rican and a majority were female (70.8%), with a mean age of 55.5 years (SD 13.71). Most had a family history of diabetes (n = 21, 87.5%) and believed they were at-risk for the disease (n = 16, 66.7%). Using Wilcoxon matched-pairs signed rank test, significant increases or improvements were found in perceptions of diabetes severity (p < .01), dietary self-efficacy (p = .002), and dietary patterns (p = .02) at posttest in comparison to baseline. Spearman's rank correlations found moderate to strong relationships between the following variables: perceived severity and weight (r’ = -.44, p = .03),
dietary self-efficacy and dietary patterns ($r = .43, p = .04$), dietary self-efficacy and fasting blood glucose levels ($r = -.45, p = .03$), and American acculturation and weight ($r = .51, p = .02$). The qualitative themes that emerged contributed to our understanding of participants' perspective relative to the health threat message, dietary skill building exercises, and the importance of cultural relevance and spirituality. The data support feasibility of this faith-based intervention that had an attendance rate of 58% and no loss of sample due to attrition.

Diabetes prevention interventions for at-risk Puerto Ricans adults that incorporate a faith-based, culturally-tailored health threat message and dietary skill building exercises may help educate those who are at-risk and motivate lifestyle behavior change to prevent the development of diabetes. Further faith-based, culturally-tailored diabetes prevention research is indicated for Puerto Rican adults.

Committee: Susan Chase (Chair), Maureen Covelli, Laura Gonzalez, Xin Yan, and Ann Miller

Graduated Spring 2015
Retrospective Correlational Analysis: Assessment of Rheumatoid Arthritis Disease Activity Using Three Indices: Health Assessment Questionnaire-Disability Index (HAQ-DI), C-Reactive Protein (CRP), and Sedimentation Rate (ESR)

ERNESTINA KYEI-DONKOR
Nursing Practice DNP

Problem: Rheumatoid arthritis affects about 1.3 million adults in the US. It causes destruction of the joints affected and results in work disability. Measuring disease activity score and treating to target has been known as an essential management strategy in RA treatment that can help minimize and or prevent the damages that tend to affect so many people with the disease.

Purpose: The purpose of the study was to retrospectively evaluate the use of three disease activity measurement indices in RA; Health Assessment Questionnaire-Disability Index, C-Reactive Protein and Erythrocyte Sedimentation Rate at an outpatient rheumatologic clinic to determine whether patterns of the indices over one year will correlate statistically with one another when used to measure RA disease severity and to determine if it is necessary for clinicians to assess all three together at the same time or if one or two could be used instead to accurately measure and assess RA disease severity.

Methods: The electronic medical records (EMR) of patients with the diagnosis of RA seen from January 1, 2013 to December 31, 2013 were selected for the review. Seventy five charts meeting the inclusive criteria were selected and their values analyzed. SPSS software was used for descriptive, correlational, and regressional analysis.

Results: A positive correlation was noted between HAQ-DI and CRP with a \( r = .376, p = .000 \). Correlation was also found between HAQ-DI and ESR \( r = .155, p = .029 \), and CRP and ESR with Pearson \( r = 0.59, p <0.001 \).

Conclusion: The independent variables of CRP and ESR are correlated to HAQ-DI. However, only the CRP was significant in predicting HAQ-DI
in the regression model. Therefore, at least two indices will be needed to evaluate RA disease activity to help treat the disease accordingly.

Committee: Christopher Blackwell (Chair), Shelly-Ann Castell, and Roberto Pancorbo

Graduated Spring 2015
Pre and Post Implementation Evaluation of an Emergency Department Severe Sepsis Alert and Practice Protocol

DARLEEN WILLIAMS
Nursing Practice DNP

Background: Severe sepsis kills an estimated 1,400 people worldwide every day. This often fatal infectious process accounts for an estimated 215,000 deaths in the United States (US) annually.

Purpose: The main goal of this project was to evaluate the impact of the Emergency Department Severe Sepsis Alert and Practice Protocol (EDSSAPP) post implementation, on time to first antibiotic administration, length of stay, and mortality in patients admitted via the ORMC ED with severe sepsis.

Methods: This study evaluated the time to first antibiotic administration, total ED and hospital length of stay (LOS) and mortality of severe sepsis patients either with a severe sepsis alert (SSA) activated or no alert activated that were admitted to the hospital through the ED. A retrospective review of the electronic medical record (EMR) was conducted to gather the required data across three time cohorts: base line/time zero (T0), six months prior to the implementation of EDSSAPP; Time one (T1) the first six months following initial EDSSAPP implementation; and Time two (T2), six months following reinstatement of the corporate sepsis committee.

Findings: The most significant finding of this study was the increased number of Severe Sepsis Alerts activated in time cohort T2 (n=113) compared to T1 (n=19). Another important finding was the decreased mortality in T2 (16.4%) compared to T0 (22.7%) and T1 (33%). Overall, the number of ED patients with severe sepsis who received antibiotics within the EDSSAPP required 60 minutes did not consistently improve across the three time cohorts, T0 (81.8%), T1 (71.7%) and T2 (80.6%). The hospital LOS of stay was increased by almost 1.5 days between those patients with a severe sepsis alert activated in T1 (9.00 days) compared to time T2 (10.48 days). There was no significant decrease in the ED LOS across time cohorts and between groups of patients who had a SSA activated versus no alert activated. However, there was a 1 hour and 28 minute decrease in ED LOS
in patients who had a severe sepsis alert activated in T1 compared to T0. In addition, there was a 1 hour and 52 minutes decrease in ED LOS between patients who had a SSA activated compared to those who had no alert activated in T2.

Conclusions: While EDSSAPP data does not demonstrate the statistically significant results that was expected, the challenges related to adherence by providers to EDSSAPP is as it is seen in the literature. Increased awareness via consistent communication of on-going audit results to ED personnel will heighten their awareness for severe sepsis and EDSSAPP. Improved collaborative efforts with the interdisciplinary team are needed to refocus everyone's efforts to increase early recognition that is followed by appropriate treatment interventions and documentation is essential. Lastly, the development of a formal process to follow up with individual providers as close to real time as possible following a SSA that includes accountability for care provided and related documentation would also contribute to both awareness and adherence.

Committee: Diane Andrews (Chair), Mary Lou Sole, and Gary Parrish

Graduated Spring 2015
Transforming the Assistant Nurse Manager Role: A Process Improvement Project Focused on Improving Perceptions of Competency through a Structured Learning Program

SHEZEL O’NEAL
Nursing Practice DNP - Executive

Problem: Nursing leadership is complicated and demanding, requiring a variety of competencies, skill, and knowledge. The culture of an organization is dependent on the strength of the leadership of the organization on all levels. Assistant Nurse Managers (ANM’s) are leaders who potentially set the front-line leadership tone for a unit or department. Often times, there is a lack of competency and skill development to support their professional growth and performance within their roles.

Purpose: The purpose of this project was to determine if there is an improved personal perception of competency and skill level of the participating ANM’s, through participation in a leadership development intervention, and to determine if there is a statistically significant improvement or difference in the reported perceptions.

Methods: Results from a self-reported pre and post survey of knowledge and ability after two months of a learning intervention was analyzed using a paired t-test and a Wilcoxon rank sum test. Forty-two valid surveys were used after the data were cleaned, and the 53 questions on the Nurse Manager Competency Inventory (NMCI) evaluated for differences in the pre and post-test means.

Results: Overall the findings from the self-reported questions on the survey demonstrated an increase in both the knowledge and understanding of the individual competencies as well as the ability to use that knowledge. There was a percentage increase in each domain of the survey ranging from 6.93-21.77% in the pre to post-test means. There was a statistically significant (p ≤ 0.05) increase in 18 out of the 53 knowledge and understanding components and 24 out of the 53 ability components, by the paired t-test. There was a statistically significant (p ≤ 0.05) increase in 28 out of the 53 knowledge and understanding components and 37 out of the 53 ability components, validated by the Wilcoxon rank sum test.
Implications: Findings suggest that a structured learning program that supports professional practice development can increase individual perceptions of competency which could potentially improve performance within leadership roles. In order to decrease gaps in leadership performance, it is vital for organizations to invest in nursing leaders and implement strategies that continuously grow their competencies and skills in order to meet the needs of a complex healthcare system.

Committee: Diane Andrews (Chair), Julee Waldrop, and Patricia Celano

Graduated Spring 2015
Utilization of a Standard Tool to Decrease the SNF Acquired Pressure Ulcer Incidence

JEFFREY CARAMEROS
Nursing Practice DNP - Family Nurse Practitioner

Purpose: Determine if addition of an AHRQ developed CNA documentation tool can be integrated into daily patient charting and if the tool would result in a decrease in the incidence of new pressure ulcers (PrUs), and earlier staging of new PrUs.

Methods: A practice improvement project was conducted in a single SNF to determine if CNA reporting impacts pressure ulcer (PrU) incidence and severity, using a pre-intervention/post-intervention design. Pre-intervention group medical records were reviewed from admission through 14 days. Post-intervention group patients then had an AHRQ derived CNA documentation tool added to their charts for CNA utilization. Medical records of the post-intervention group were reviewed for 14 days for evidence of decreased PrU incidence and severity compared to the pre-intervention group. Charts of patients were reviewed before and after intervention with data categorized into two sample groups: a pre-intervention group (N=21) and a post-intervention group (N=13).

Results: Data determined that CNA documentation tool utilization improved cross-level communication for the prevention, earlier identification, and decreased incidence of PrUs. A clinically significant decrease in PrU incidence between the pre- and post-intervention groups was identified. Without any new PrU in the post-intervention group, earlier PrU staging assessments were impossible.

Conclusion: Utilization of an AHRQ developed CNA documentation tool may help decrease incidence of new SNF-acquired PrUs and lead to earlier staging. Longer follow-up would be necessary to determine if continuation of the use of the CNA documentation tool is maintainable and if usage may affect PrU incidence over a patient’s complete admission.

Committee: Angela Ritten (Chair), Julee Waldrop, and Myra Downing-Sherman

Graduated Spring 2015
Improving Depression Screening in Caregiver Patients in Primary Care

DEBORAH DARNELL
Nursing Practice DNP - Family Nurse Practitioner

Purpose: To determine if PHQ-9 scores aid primary care providers’ (PCPs) diagnosis and treatment of depression in patients acting as caregivers and if patients are compliant with provider plan for return to clinic. To describe PCP’s intervention with chronic illness, caregiver resources and preventative healthcare needs.

Method: A descriptive study was conducted to evaluate a practice initiative involving caregiver patients (n=23) at two primary care locations from March 1 thru May 20, 2015. Retrospective medical record review was utilized to collect data in two phases over 60 days post practice initiative.

Results: PHQ-9 results indicated depression in 22 (96%) caregivers; thirteen (57%) had previous history of depression; four (30.8%) patients with previous depression had treatment changes. PCPs made no new diagnoses of depression. Twenty (87%) were requested to return to clinic; 13 (65%) returned. Six (55%) caregivers returned per provider recommendation of 2 to 4 weeks. Four caregivers (17%) received caregiver resources; one reported resources not used. Providers addressed chronic illness in 100% of returning caregivers. Nine (69%) returning caregivers had preventative healthcare needs; PCPs addressed needs in six (46%) returning caregivers.

Conclusion: PHQ-9 scores indicating depression did not facilitate PCP diagnoses of new depression. Most caregivers returned to clinic, but not at PCP recommended interval. PCPs did not address many healthcare needs of caregiver patients upon return to clinic. Further study is necessary to inform consistent identification and screening of caregiver patients for depression. Additional studies should also include ways to increase caregiver utilization of preventative health services and utilization of resources.

Committee: Angela Ritten (Chair), Kathe Hypes, and Mary Theresa Izzo

Graduated Summer 2015
A Process Improvement Project to Increase Participation in Diabetes Self-Management Education in Primary Care

JONATHAN PEACH

Nursing Practice DNP - Family Nurse Practitioner

Problem: In the United States only 6.8% of clients with diabetes mellitus (DM) attended a diabetes self-management education (DSME) class within the first year of diagnosis, in 2012. Clients who attend DSME within the first year of diagnosis are more likely to be receptive to disease-specific self-management information. Overall only 57.4% of clients with DM have ever attended a DSME program. This figure is well below the Healthy People 2020 goal of 62.5%. One reason cited for low attendance to DSME was poor referrals by providers.

Methods: A pre/post-intervention design was used to evaluate attendance of referred clients to a DSME program. A chi-square analysis was used to compare attendance between the pre-intervention and post-intervention groups.

Results: In the pre-intervention group (between April 4, 2013 and December 31, 2014) there were 59 clients referred with 23 attending (38.9%). The post-intervention group (January 1, 2015 to March 31, 2015) referred 34 clients with 6 attending (17.6%). For this study N = 93, which included 47 (50.5%) males and 46 (49.5%) females.

Conclusion: There was no statistically significant difference in the attendance of the post-intervention group (p = 0.220), but in the 3 month long post-intervention group there was an increase of 57.6% in amount of referrals when compared to the pre-intervention 20 month time period. While there was no statistically significant difference in the attendance in the pre and post-intervention groups, there was a dramatic increase in the number of clients referred in the shorter time frame of the post intervention
phase. Data will continue to be collected to continue evaluation of the effectiveness of the process change.

Committee: Paul Desmarais (Chair), Donna Neff, Jacqueline LaManna, and Pedro Ortega

Graduated Spring 2015
An Implementation Project to Improve Provider Review and Recommendation of Immunizations in Adult Patients with Psoriasis Receiving Biologic Therapy

DAWN TURNAGE
Nursing Practice DNP - Family Nurse Practitioner

**Problem:** Psoriasis is an autoimmune skin disorder. Treatments with biologic agents target the immune system and make patients vulnerable to infection. Guidelines from the National Psoriasis Foundation (NPF) recommend that patients remain up to date with immunizations. Implementation of a provider reminder could increase providers’ review and recommendation of immunizations.

**Purpose:** The purpose of this project was to determine whether implementation of a provider reminder increases the instances of provider review of immunization history and recommendation of the herpes zoster, influenza, and pneumonia vaccines in patients receiving or starting biologics.

**Method:** A descriptive study was conducted pre- and post-intervention (N = 20) over three months in a dermatology practice. A patient questionnaire was implemented to serve as a provider reminder to review immunization status and recommend vaccines. Review was measured by provider signature on the questionnaire. Recommendation was measured by documentation within the provider’s note.

**Results:** Findings showed that there was a statistically significant increase in provider review of immunization status, with 90% more provider reviews post-intervention than at baseline (p < 0.0001). There was also a 35% increase in provider recommendations of influenza vaccine (p = 0.0233), although this rate did not reflect that several patients had already received the vaccine. Recommendation rates were unable to be calculated for live attenuated herpes zoster vaccine, as many patients had already received or were clinically inappropriate to receive the vaccine while taking a biologic. Recommendation rates were unable to be calculated for the pneumonia vaccine, as several patients previously received the vaccine. Also, while providers made no recommendations for the pneumonia vaccine, 65% of patients (n = 13) met criteria for the vaccine.
Conclusion: Use of a reminder tool is effective for improving provider review of immunizations and for recommendation of influenza vaccine, but effectiveness for recommendation of pneumonia and herpes zoster vaccines was unable to be calculated. Providers may benefit from a review of guidelines for the pneumonia vaccine, where immunocompromised patients 19-64 years of age should be vaccinated. The reminder tool may also serve to initiate conversation between patient and provider about necessary immunizations to prevent infection.

Committee: Christopher Blackwell (Chair), Diane Wink, Loretta Forlaw, and Amy Wells

Graduated Spring 2015
College of OPTICS AND PHOTONICS
Transverse Mode Selection and Brightness Enhancement in Laser Resonators by Means of Volume Bragg Gratings

BRIAN ANDERSON
Optics and Photonics PhD

The design of high power lasers requires large mode areas to overcome various intensity driven nonlinear effects. Increasing the aperture size within the laser can overcome these effects, but typically result in multi-transverse mode output and reduced beam quality, limiting the brightness of the system. As one possible solution, the angular selectivity of a diffractive optical element is proposed as a spatial filter, allowing for the design of compact high brightness sources not possible with conventional methods of transverse mode selection. This thesis explores the angular selectivity of volume Bragg gratings (VBGs) and their use as spatial transverse mode filters in a laser resonator.

Selection of the fundamental mode of a resonator is explored using transmission Bragg gratings (TBGs) as the spatial filter. Simulations and experimental measurements are made for a planar, 1 cm long resonator demonstrating near diffraction limited output ($M^2 < 1.4$) for aperture sizes as large as 2.0 mm. Applications to novel fiber laser designs are explored. Single mode operation of a multi-mode Yb$^{3+}$ doped ribbon fiber laser (core dimensions of 107.8 µm x 8.3 µm) is obtained using a single transmission VBG as the filter in an external cavity resonator.

Finally, a novel method of selecting a pure higher order mode to oscillate within the gain medium while simultaneously converting this higher order mode to a fundamental mode at an output coupler is proposed and demonstrated. A multiplexed transmission VBG is used as the mode converting element, selecting the 12th higher order mode for amplifications in an Yb$^{3+}$ doped ribbon fiber laser, while converting the higher order mode of a laser resonator to a single lobed output beam with diffraction limited divergence.

Committee: Leonid Glebov (Chair), Boris Zeldovich, Axel Schulzgen, and Talat Rahman

Graduated Summer 2015
Towards High-Flux Isolated Attosecond Pulses with a 200 TW CPA

ERIC CUNNINGHAM
Optics and Photonics PhD

Attosecond pulses have been developed as a means for investigating phenomena that proceed on the order of the atomic unit of time (24 as). Unfortunately, these extreme ultraviolet (XUV) pulses by themselves contain too few photons to initiate nonlinear dynamics or dress states in an attosecond pump—attosecond probe scheme. As a result, most attosecond experiments thus far have featured complementary near infrared (NIR) femtosecond lasers for instigating electron dynamics. In order to access the benefits of all-attosecond measurements and open attosecond physics to new fields of exploration, the photon flux of these pulses must be increased.

One way to boost the attosecond pulse energy is to scale up the energy of the NIR pulse responsible for driving high-harmonic generation (HHG). With generalized double optical gating (GDOG), isolated attosecond pulses can be generated with multi-cycle laser systems, wherein the pulse energy can be boosted more easily than in the few-cycle laser systems required by other gating methods. At the Institute for the Frontier of Attosecond Science and Technology (IFAST), this scalability was demonstrated using a 350 mJ, 15 fs (10 TW) Ti:sapphire laser, which was used to generate a 100 nJ XUV continuum. This represented an order-of-magnitude improvement over typical attosecond pulse energies achievable by millijoule-level few-cycle lasers.

To obtain the microjoule-level attosecond pulse energy required for performing all-attosecond experiments, the attosecond flux generated by the IFAST 10 TW system was still deficient by an order of magnitude. To this end, the laser system was upgraded to provide joule-level output energies while maintaining pulse compression to 15 fs, with a targeted peak power of 200 TW. This was accomplished by adding an additional Ti:sapphire amplifier to the existing 10 TW system and implementing a new pulse compression system to accommodate the higher pulse energy.

Because this system operated at a 10 Hz repetition rate, stabilization of the carrier-envelope phase (CEP)—important for controlling attosecond pulse
production—could not be achieved using traditional methods. Therefore, a new scheme was developed, demonstrating the first-ever control of CEP in a chirped-pulse amplifier (CPA) at low repetition rates.

Finally, a new variation of optical gating was proposed as a way to improve the efficiency of the attosecond pulse generation process. This method was also predicted to allow for the generation of isolated attosecond pulses with longer driving laser pulses, as well as the extension of the high-energy photon cut-off of the XUV continuum.

Committee: Zenghu Chang (Chair), Bahaa Saleh, M. J. Soileau, and Haripada Saha

Graduated Fall 2015
Atmospheric Pressure Chemical Vapor Deposition of Functional Oxide Materials for Crystalline Silicon Solar Cells

KRISTOPHER DAVIS
Optics and Photonics PhD

Functional oxides are versatile materials that can simultaneously enable efficiency gains and cost reductions in crystalline silicon (c-Si) solar cells. In this work, the deposition of functional oxide materials using atmospheric pressure chemical vapor deposition (APCVD) and the integration of these materials into c-Si solar cells are explored. Specifically, thin oxide films and multi-layer film stacks are utilized for the following purposes: (1) to minimize front surface reflectance without increasing parasitic absorption within the anti-reflection coating(s); (2) to maximize internal back reflectance of rear passivated cells, thereby increasing optical absorption of weakly absorbed long wavelength photons ($\gamma > 900$ nm); (3) to minimize recombination losses by providing excellent surface passivation; and (4) to improve doping processes during cell manufacturing (e.g., emitter and surface field formation) by functioning as highly controllable dopant sources compatible with in-line diffusion processes. The oxide materials deposited by APCVD include amorphous and polycrystalline titanium oxide ($\text{a-TiO}_x$ and $\text{pc-TiO}_x$, respectively), aluminum oxide ($\text{AlO}_x$), boron-doped $\text{AlO}_x$ ($\text{AlO}_x$:B), silicon oxide ($\text{SiO}_x$), phosphosilicate glass (PSG), and borosilicate glass (BSG). The microstructure, optical properties, and electronic properties of these films are characterized for different deposition conditions. Additionally, the impact of these materials on the performance of different types of c-Si solar cells is presented using both simulated and experimental current-voltage ($I-V$ and $J-V$) curves.

Committee: Winston Schoenfeld (Chair), Patrick Likamwa, Jim Moharam, and Dirk Habermann

Graduated Spring 2015
Supercontinuum (SC) generation, oftentimes referred to as white-light continuum (WLC), has been a subject of interest for more than 40 years. From the first observation of WLC in condensed media in the early 1970s to the first observation of WLC in gases in the mid-1980s, much work has been devoted to developing a framework for understanding the complex nature of this phenomenon as well as discovering its utility in various applications.

The main effort of this dissertation is to develop a WLC for the purpose of broadband nonlinear spectroscopy and use it in spectroscopic measurements. The ability to generate a high-quality, high-spectral-irradiance source of radiation confined in a single beam that spans the visible and near-infrared spectral regimes has great utility for nonlinear measurement methods such as the Z-scan technique. Using a broadband WLC instead of conventional tunable sources of radiation such as optical parametric generators/amplifiers has been shown to increase the efficiency of such measurements by nearly an order of magnitude.

Although WLC generation has many complex processes involved, and complete models of the process involve highly complex numerical modeling, simple models can still guide us in the optimization of systems for WLC generation. In this dissertation the effects of two key mechanisms behind WLC generation in gaseous media are explored: self-phase modulation (SPM) and ionization leading to plasma production. The effects of SPM are largely dependent upon the third-order nonlinear refractive index, $n_2$, of the gaseous medium whereas the effects of plasma production are dependent upon many parameters including the initial number density, ionization potential/energy, and the rate of ionization production. It is found that in order to generate a stable WLC suitable for nonlinear spectroscopy, the phase contributions from SPM and plasma production should be nearly equal. This guided our experiments in inert gases using mJ level, 150 fs-FWHM (full-width at half-maximum) pulses at 780 nm as well as 40 fs-FWHM pulses primarily at 1800 nm to create a stable, high-spectral-
irradiance WLC. The generated WLC is shown to have sufficient spectral energy and spatial quality suitable for nonlinear spectroscopic measurements.

In addition to extending the WLC bandwidth by using a long wavelength (1800 nm) pump source, it is found that by using a secondary weak seed pulse with a peak irradiance three orders of magnitude less than the main pulse, the spectral energy density is enhanced by more than a factor of 3 in Krypton gas for a WLC spectrum that spans over 2 octaves. Numerical simulations are presented which qualitatively describe the experimental results. The spectral enhancement of the WLC by seeding is also demonstrated for other inert gases and condensed media.

Other efforts described in this dissertation include the development of the Dual-Arm Z-scan technique and its extension to measuring thin film nonlinearities in the presence of large substrate signals as well as predicting the $n_2$ spectra of organic molecules (where we can approximate their behavior as if they were centrosymmetric) from knowledge of the one-photon and two-photon absorption spectra using a simplified sum-over-states quantum perturbative model by utilizing a quasi 3-level and quasi 4-level system.

Committee: David Hagan (Chair), Eric Vanstryland, Boris Zeldovich, Demetrios Christodoulides, and Alfons Schulte

Graduated Spring 2015
Liquid Crystal-Based Biosensors for the Detection of Bile Acids

SIHUI HE
Optics and Photonics PhD

Bile acids are physiologically important metabolites, which are synthesized in liver as the end products of cholesterol metabolism and then secreted into intestine. They are amphiphilic molecules which play a critical role in the digestion and absorption of fats and fat-soluble vitamins through emulsification. The concentration of bile acids is an indicator for liver function. Individual suffering from liver diseases has a sharp increase in bile acid concentrations. Hence, the concentration level of bile acids has long been used as a biomarker for the early diagnosis of intestinal and liver diseases.

Conventional methods of bile acid detection such as chromatography-mass spectrometry and enzymatic reactions are complex and expensive. It is highly desired to have a simple, fast, and low-cost detection of bile acids that is available for self-testing or point-of-care testing. To achieve this goal, we develop a liquid crystal-based biosensor for the detection of bile acids. The sensor platform is based on the anchoring transition of liquid crystals (LCs) at the sodium dodecyl sulfate (SDS)-laden LC/aqueous interface for the detection of bile acids in aqueous solution. The first part of this dissertation focuses on the detection mechanism of bile acids. Our studies show that the displacement of SDS from the LC/aqueous interface by the competitive adsorption of bile acids induces a homeotropic-to-planar anchoring transition of the LC at the interface, providing an optical signature for the simple and rapid detection of bile acids. The adsorption of bile acids on the interface was found to follow Langmuir-Freundlich isotherm. The adsorption kinetics of different bile acids is compared. We find that both the number and position of hydroxyl groups of bile acids affect their adsorption kinetics. The different optical patterns of LC films formed by the adsorption of bile acids are also discussed.

The second part of this dissertation studies the effect of solution conditions, surfactants, and liquid crystals on the detection limit of the LC-based biosensor for bile acids. Low pH and high ionic strength in the aqueous solution can reduce the electrostatic interaction between SDS and bile
acids, which leads to a decreased detection limit. Surfactants with smaller
headgroup and lower packing density also help to reduce the detection
limit. To further reduce the detection limit, we investigate the effect of
LC structures and find that LCs with a shorter chain length give lower
detection limits. Also, by substituting a phenyl ring with a cyclohexane
ring, we find that the detection limit is further reduced due to the decrease
of the interaction between the phenyl rings of LCs. By mixing different
LCs together, the detection limit can be linearly tuned from 160 µM to 1.5
µM, which is comparable to the traditional methods. But the LC-based
biosensors have much simpler design and manufacture process.

The third part of this dissertation is to apply this LC-based biosensor to
the detection of urinary bile acids. We test the influence of several potential
interfering species such as urea, creatinine, uric acid and ascorbic acid by
conducting experiments in synthetic urine. By adjusting the concentration
of SDS, we are able to eliminate the impact of those interfering species,
and demonstrate that the LC-based biosensors can selectively detect
urinary bile acids in human urine, suggesting its potential for screening liver
dysfunctions.

The final part of this dissertation is to investigate the application of LC-
based biosensors in detecting the lipolysis process by porcine pancreatic
lipase (PPL). It has been a long-standing argument over the role of bile
salts on the activity of PPL. Thus, we study the time course of the hydrolysis
of phospholipid L-dipalmitoylphosphatidylcholine (L-DPPC) by PPL at
LC/aqueous interface. The hydrolysis of L-DPPC leads to a homeotropic-
to-tilted anchoring transition of the LC at the interface, which allows the
hydrolysis process to be monitored by a polarizing optical microscope. The
microscopy image analysis reveals a lag-burst kinetics where a lag phase
is followed by a burst phase. The effect of bile acids on these two phases is
studied. We find that the activity of PPL both in the presence and absence
of colipase can be improved by increasing the concentration of bile acids. The
improvement becomes more distinct in the presence of colipase.

Committee: Shintson Wu (Chair), Stephen Kuebler, Pieter Kik, and Jiyu
Fang

Graduated Summer 2015
Photon Statistics in Disordered Lattices

HASAN KONDAKCI
Optics and Photonics PhD

Propagation of coherent waves through disordered media, whether optical, acoustic, or radio waves, results in a spatially redistributed random intensity pattern known as speckle—a statistical phenomenon. The subject of this dissertation is the statistics of monochromatic coherent light traversing disordered photonic lattices and its dependence on the disorder class, the level of disorder and the excitation configuration at the input. Throughout the dissertation, two disorder classes are considered, namely, diagonal and off-diagonal disorders. The latter exhibits disorder-immune chiral symmetry—the appearance of the eigenmodes in skew-symmetric pairs and the corresponding eigenvalues in opposite signs.

When a disordered photonic lattice, an array of evanescently coupled waveguides, is illuminated with an extended coherent optical field, discrete speckle develops. Numerical simulations and analytical modeling reveal that discrete speckle shows a set of surprising features, that are qualitatively indistinguishable in both disorder classes. First, the fingerprint of transverse Anderson localization, associated with disordered lattices, is exhibited in the narrowing of the spatial coherence function. Second, the transverse coherence length (or speckle grain size) freezes upon propagation. Third, the axial coherence depth is independent of the axial position, thereby resulting in a coherence voxel of fixed volume independently of position.

When a single lattice site is coherently excited, I discovered that a thermalization gap emerges for light propagating in disordered lattices endowed with disorder-immune chiral symmetry. In these systems, the span of sub-thermal photon statistics is inaccessible to the input coherent light, which—once the steady state is reached—always emerges with super-thermal statistics no matter how small the disorder level. An independent constraint of the input field for the chiral symmetry to be activated and the gap to be observed is formulated. This unique feature enables a new form of photon-statistics interferometry: by exciting two lattice sites with a variable relative phase, as in a traditional two-path interferometer, the excitation-symmetry of the chiral mode pairs is judiciously broken and interferometric control over the photon statistics is exercised, spanning sub-thermal and super-thermal regimes. By considering an ensemble of disorder realizations,
this phenomenon is demonstrated experimentally: a deterministic tuning of the intensity fluctuations while the mean intensity remains constant.

Finally, I examined the statistics of the emerging light in two different lattice topologies: linear and ring lattices. I showed that the topology dictates the light statistics in the off-diagonal case: for even-sited ring and linear lattices, the electromagnetic field evolves into a single quadrature component, so that the field takes discrete phase values and is non-circular in the complex plane. As a consequence, the statistics become super-thermal. For odd-sited ring lattices, the field becomes random in both quadratures resulting in sub-thermal statistics. However, this effect is suppressed due to the transverse localization of light in lattices with high disorder. In the diagonal case, the lattice topology does not play a role and the transmitted field always acquires random components in both quadratures, hence the phase distribution is uniform in the steady state.

Committee: Bahaa Saleh (Chair), Ayman Abouraddy, Demetrios Christodoulides, and Eduardo Mucciolo

Graduated Fall 2015
High Efficiency and Wide Color Gamut Liquid Crystal Displays

ZHENYUE LUO
Optics and Photonics PhD

Liquid crystal display (LCD) has become ubiquitous and indispensable in our daily life. Recently, it faces strong competition from organic light emitting diode (OLED). In order to maintain a strong leader position, LCD camp has an urgent need to enrich the color performance and reduce the power consumption. This dissertation focuses on solving these two emerging and important challenges.

In the first part of the dissertation we investigate the quantum dot (QD) technology to improve the both the color gamut and the light efficiency of LCD. QD emits saturated color and grants LCD the capability to reproduce color vivid images. Moreover, the QD emission spectrum can be custom designed to match to transmission band of color filters. To fully take advantage of QD’s unique features, we propose a systematic modelling of the LCD backlight and optimize the QD spectrum to simultaneously maximize the color gamut and light efficiency. Moreover, QD enhanced LCD demonstrates several advantages: excellent ambient contrast, negligible color shift and controllable white point. Besides three primary LCD, We also present a spatiotemporal four-primary QD enhanced LCD. The LCD’s color is generated partially from time domain and partially from spatial domain. As a result, this LCD mode offers 1.5× increment in spatial resolution, 2× brightness enhancement, slightly larger color gamut and mitigated LC response requirement (~4ms). It can be employed in the commercial TV to meet the challenging Energy star 6 regulation. Besides conventional LCD, we also extend the QD applications to liquid displays and smart lighting devices.

The second part of this dissertation focuses on improving the LCD light efficiency. Conventional LCD system has fairly low light efficiency (4%~7%) since polarizers and color filters absorb 50% and 67% of the incoming light respectively. We propose two approaches to reduce the light loss within polarizers and color filters. The first method is a polarization preserving backlight system. It can be combined with linearly polarized light source to boost the LCD efficiency. Moreover, this polarization preserving backlight
offers high polarization efficiency (~77.8%), 2.4× on-axis luminance enhancement, and no need for extra optics films. The second approach is a LCD backlight system with simultaneous color/polarization recycling. We design a novel polarizing color filter with high transmittance (>90%), low absorption loss (~3.3%), high extinction ratio (>10,000:1) and large angular tolerance (up to ±50°). This polarizing color filter can be used in LCD system to introduce the color/polarization recycling and accordingly boost LCD efficiency by ~3 times. These two approaches open new gateway for ultra-low power LCDs.

In the final session of this dissertation, we demonstrate a low power and color vivid reflective liquid crystal on silicon (LCOS) display with low viscosity liquid crystal mixture. Compared with commercial LC material, the new LC mixture offers ~4× faster response at 20°C and ~8× faster response at -20°C. This fast response LC material enables the field-sequential-color (FSC) driving for power saving. It also leads to several attractive advantages: sub-millisecond response time at room temperature, vivid color even at -20°C, high brightness, excellent ambient contrast ratio, and suppressed color breakup. With this material improvement, LCOS display can be promising for the emerging wearable display market.

Committee: Shintson Wu (Chair), Pieter Kik, Winston Schoenfeld, and Jiyu Fang

Graduated Summer 2015
Optical Propagation of Self-sustaining Wavefronts and Nonlinear Dynamics in Parabolic Multimode Fibers

MATTHEW MILLS
Optics and Photonics PhD

The aim of this thesis is to introduce my work which has generally been focused on optical wavefronts that have the unusual property of resisting commonplace phenomena such as diffraction and dispersion. Interestingly, these special beams are found both in linear and nonlinear situations. For example, in the linear regime, localized spatio-temporal waves which resemble the spherical harmonic symmetries of the hydrogen quantum orbitals can simultaneously negotiate both diffractive and dispersive effects. In the nonlinear regime, dressed optical filaments can be arranged to propagate multi-photon produced plasma channels orders of magnitude longer than expected.

The first portion of this dissertation will begin by surveying the history of diffraction-free beams and introducing some of their mathematical treatments. Interjected throughout this discussion will be several relevant concepts which I explored during my first years at CREOL. The discussion will then be steered into a detailed account of diffraction/dispersion free wavefronts which display hydrogen-like symmetries. The second segment of the document will cover the highly nonlinear process of optical filamentation. This chapter will almost entirely investigate the idea of the dressed filament, an entity which allows for substantial prolongation of this light string. I will then conclude by delving into the topic of supercontinuum generation in parabolic multimode fibers which, in the upcoming years, has great potential of becoming important in optics.

Committee: Demetrios Christodoulides (Chair), David Hagan, Aristide Dogariu, and David Kaup

Graduated Fall 2015
Two-photon Absorption in Bulk Semiconductors and Quantum Well Structures and Its Applications

HIMANSU PATTANAIK
Optics and Photonics PhD

The purpose of this dissertation is to provide a study and possible applications of two-photon absorption (2PA), in direct-gap semiconductors and quantum-well (QW) semiconductor structures. One application uses extremely nondegenerate (END) 2PA, for mid-infrared (mid-IR) detection in uncooled semiconductors. The use of END, where the two photons have very different energies gives strong enhancement compared to degenerate 2PA. This END-2PA enhanced detection is also applied to mid-IR imaging and light detection and ranging (LIDAR) in uncooled direct-gap photodiodes. A theoretical study of degenerate 2PA (D-2PA) in quantum wells, QWs, is presented, along with a new theory of ND 2PA in QWs is developed.

Pulsed mid-IR detection of femtosecond pulses is investigated in two different semiconductor p-i-n photodiodes (GaAs and GaN). With the smaller gap materials having larger ND-2PA, it is observed that they have better sensitivity to mid-IR detection, but unwanted background from D-2PA outweighs this advantage. A comparison of responsivity and signal-to-background ratio for GaAs and GaN in END-2PA based detection is presented. END-2PA enhancement is utilized for CW IR detection in uncooled GaAs and GaN p-i-n photodiodes.

The pulsed mid-IR detection experiments are further extended to perform mid-IR imaging in uncooled GaN p-i-n photodetectors. A 3-D automated scanning gated imaging system is developed to obtain 3-D mid-IR images of various objects. The gated imaging system allows simultaneous 3-D and 2-D imaging of objects. The 3-D gated imaging system described in the dissertation could be used for examination of buried structures (microchannels, defects etc.) or laser written volumetric structures and could also be suitable for in-vivo imaging applications in biology in the mid-IR spectral region. As an example, 3-D imaging of buried semiconductor structures is presented.
A theoretical study of D-2PA of QWs for transverse electric (TE) and transverse magnetic (TM) fields is carried out and an analytical expression for the D-2PA coefficient in QWs using second-order perturbation theory is derived. A theory for ND-2PA in QW semiconductor using second-order perturbation theory is developed for the first time and an analytical expression for the ND-2PA coefficient for TE, TM, and the mixed case of TE and TM is derived. The shape of the 2PA curve for the D-2PA and ND-2PA for QWs in the TE case is similar to that of bulk semiconductors. As governed by the selection rules both the D-2PA and ND-2PA curves for the TE case do not show a step-like signature for the density of states of the QWs whereas 2PA curve for the TM case shows such step like sharp features. The ND-2PA coefficient for TE, TM, and the mixed case is compared with that obtained for bulk semiconductors. Large enhancement in ND-2PA of QW semiconductors for the TM case over bulk semiconductors is predicted.

Committee: Eric Vanstryland (Chair), David Hagan, Peter Delfyett, Winston Schoenfeld, and Robert Peale

Graduated Spring 2015
Nonlinear Optical Response of Simple Molecules and Two-Photon Semiconductor Lasers

MATTHEW REICHERT
Optics and Photonics PhD

This dissertation investigates two long standing issues in nonlinear optics: complete characterization of the ultrafast dynamics of simple molecules, and the potential of a two-photon laser using a bulk semiconductor gain medium.

Within the Born-Oppenheimer approximation, nonlinear refraction in molecular liquids and gases can arise from both bound-electronic and nuclear origins. Knowledge of the magnitudes, temporal dynamics, polarization and spectral dependences of each of these mechanisms is important for many applications including filamentation, white-light continuum generation, all-optical switching, and nonlinear spectroscopy. In this work the nonlinear dynamics of molecules are investigated in both liquid and gas phase with the recently developed beam deflection technique which measures nonlinear refraction directly in the time domain. Thanks to the utility of the beam deflection technique we are able to completely determine the third-order response function of one of the most important molecular liquids in nonlinear optics, carbon disulfide. This allows the prediction of essentially any nonlinear refraction or two-photon absorption experiment on CS₂. Measurements conducted on air (N₂ and O₂) and gaseous CS₂ reveal coherent rotational revivals in the degree of alignment of the ensemble at a period that depends on its moment of inertia. This allows measurement of the rotational and centrifugal distortion constants of the isolated molecules. Additionally, the rotational contribution to the beam deflection measurement can be eliminated thanks to the particular polarization dependence of the mechanism. At a specific polarization, the dominant remaining contribution is due to the bound-electrons. Thus both the bound-electronic nonlinear refractive index of air, and second hyperpolarizability of isolated CS₂ molecules, are measured directly. The later agrees well with liquid CS₂ measurements, where local field effects are significant.

The second major portion of this dissertation addresses the possibility of using bulk semiconductors as a two-photon gain medium. A two-photon laser has been a goal of nonlinear optics since shortly after the original laser’s
development. In this case, two-photons are emitted from a single electronic transition rather than only one. This process is known as two-photon gain (2PG). Semiconductors have large two-photon absorption coefficients, which are enhanced by ~2 orders of magnitude when using photons of very different energies, e.g., $\hbar \omega_a \approx 10 \hbar \omega_b$. This enhancement should translate into large 2PG coefficients as well, given the inverse relationship between absorption and gain. Here, we experimentally demonstrate both degenerate and nondegenerate 2PG in optically excited bulk GaAs via pump-probe experiments. This constitutes, to my knowledge, the first report of nondegenerate two-photon gain. Competition between 2PG and competing processes, namely intervalence band and nondegenerate three-photon absorption (ND-3PA), in both cases are theoretically analyzed. Experimental measurements of ND-3PA agree with this analysis and show that it is enhanced much more than ND-2PG. It is found for both degenerate and nondegenerate photon pairs that the losses dominate the two-photon gain, preventing the possibility of a two-photon semiconductor laser.

Committee: Eric Vanstryland (Chair), David Hagan (Co-Chair), Patrick Likamwa, and Robert Peale

Graduated Summer 2015
True Linearized Intensity Modulation for Photonic Analog to Digital Conversion Using an Injection-locked Mode-locked Laser

EDRIS SARAILOU
Optics and Photonics PhD

A true linearized interferometric intensity modulator for pulsed light has been proposed and experimentally presented in this thesis. This has been achieved by introducing a mode-locked laser into one of the arms of a Mach-Zehnder interferometer and injection-locking it to the input light (which is pulsed and periodic). By modulating the injection-locked laser, and combining its output light with the light from the other arm of interferometer in quadrature, one can achieve true linearized intensity modulator. This linearity comes from the arcsine phase response of the injection-locked mode-locked laser (as suggested by steady-state solution of Adler’s equation) when it is being modulated.

Mode-locked lasers are fabricated using a novel AlGaInAs-InP material system. By using the BCB for planarization and minimizing the metal pad size and directly modulating the laser, we have achieved very effective fundamental hybrid mode-locking at the repetition rate of ~ 23 GHz. This laser also provided the short pulses of 860 fs and 280 fs timing jitter integrated from 1 Hz- 100 MHz.

The linearized intensity modulator has been built by using two identical two-section mode-locked lasers with the same length, one as the slave laser in one of the arms of the Mach-Zehnder interferometer injection-locked to the other one as the master which is the input light to the modulator. A low $V_n$ of 8.5 mV is achieved from this modulator. Also the current of the gain section or the voltage of the saturable absorber section of the slave laser has been used to apply the modulation signal. A spur free dynamic range of 70 dB Hz$^{2/3}$ is achieved when modulating the modulator through the saturable absorber. Modulating the saturable absorber provides a reduced third-order intermodulation tone with respect to modulating the gain. This is simply because of the unwanted amplitude modulation created when modulating the gain section current.
Finally an improved design is proposed and demonstrated to improve the modulator performance. This is achieved by introducing a third section to the laser. Using the impurity free vacancy disordering technique the photoluminescence peak of this section is blue-shifted selectively and therefore there would not be any absorption in that passive section. By applying the modulation signal to this passive section rather than applying it to the gain section or saturable absorber section, the amplitude and phase modulation could be decoupled. The experimental results have presented here and an almost six-fold reduction in $V_n$ and 5 dB improvement in spur free dynamic range have been achieved. The proposed and demonstrated configuration as an analog optical link has the potential to increase the performance and resolution of photonic analog-to-digital converters.

Committee: Peter Delfyett (Chair), Patrick Likamwa, Susan Fathpour, and Donald Malocha

Graduated Spring 2015
Optical Fibers for Space-Division Multiplexed Transmission and Networking

CEN XIA
Optics and Photonics PhD

Single-mode fiber transmission can no longer satisfy exponentially growing capacity demand. Space-division multiplexing (SDM) appears to be the only way able to dramatically improve the transmission capacity, for which, novel optical fiber is one of the key technologies. Such fibers must possess the following characteristics: 1) high mode density per cross-sectional area and 2) low crosstalk or low modal differential group delay (DMGD) to reduce complexity of digital signal processing. In this dissertation, we explore the design and characterization of three kinds of fibers for SDM: few-mode fiber (FMF), few-mode multi-core fiber (FM-MCF) and coupled multi-core fiber (CMCF) as well as their applications in transmission and networking.

For the ultra-high density need of SDM, we have proposed the FMMCF. It combines advantages of both the FMF and MCF. The challenge is the inter-core crosstalk of the high-order modes. By applying a hole-assisted structure and careful fiber design, the LP_{11} crosstalk has been suppressed down to -40dB per km. This allows separate transmission on LP_{01} and LP_{11} modes without penalty. In fact, a robust SDM transmission up to 200Tb/s has been achieved using this fiber.

To overcome distributed modal crosstalk in conjunction with DMGD, supermodes in CMCFs have been proposed. The properties of supermodes were investigated using the coupled-mode theory. The immediate benefits include high mode density and large effective area. In supermode structures, core-to-core coupling is exploited to reduce modal crosstalk or minimize DMGD. In addition, higher-order supermodes have been discovered in CMCFs with few-mode cores. We show that higher-order supermodes in different waveguide array configurations can be strongly affected by angle-dependent couplings, leading to different modal fields. Analytical solutions are provided for linear, rectangular and ring arrays. Higher-order modes have been observed for the first time using S² imaging method.

Finally, we introduce FMF to gigabit-capable passive optical networks (GPON). By replacing the conventional splitter with a photonic lantern,
upstream combining loss can be eliminated. Low crosstalk has been achieved by a customized mode-selective photonic lantern carefully coupled to the FMF. We have demonstrated the first few-mode GPON system with error-free performance over 20-km 3-mode transmission using a commercial GPON system carrying live Ethernet traffic. We then scale the 3-mode GPON system to 5-mode, which resulted in a 4dB net gain in power budget in comparison with current commercial single-mode GPON systems.

Committee: Guifang Li (Chair), Jim Moharam, Ayman Abouraddy, Demetrios Christodoulides, and Thomas Wu

Graduated Summer 2015
College of SCIENCES
A Binary Approach for Selective Recognition of Nucleic Acids and Proteins

EVAN CORNETT
Biomedical Sciences PhD

The design of probes for the selective recognition of biopolymers (nucleic acids and proteins) is a fundamental task for studying, diagnosing, and treating diseases. Traditional methods utilize a single component (small molecule or oligonucleotide) that binds directly to the target biopolymer. However, many biopolymers are unable to be targeted with this approach. The overarching goal of this dissertation is to explore a new, binary approach for designing probes. The binary approach requires two components that cooperatively bind to the target, triggering a recognition event. The requisite binding of two-components allows the probes to have excellent selectivity and modularity.

The binary approach was applied to design a new sensor, called operating cooperatively (OC) sensor, for recognition of nucleic acids, including selectively differentiating between single nucleotide polymorphisms (SNPs). An OC sensor contains two oligonucleotide probe strands, called O and C, each with two domains. The first domain contains a target recognition sequence, whereas the second domain is complementary to a molecular beacon (MB) probe. Binding of both probe strands to the fully matched analyte generates a full MB probe recognition site, allowing a MB to bind and report the presence of the target analyte. Importantly, we show that the OC sensor selectively discriminates between single nucleotide polymorphisms (SNPs) in DNA and RNA targets at room temperature, including those with stable secondary structures. Furthermore, the combinatorial use of OC sensors to create a DNA logic gate capable of analyzing DNA sequences of *Mycobacterium tuberculosis* is described.

The binary approach was also applied to design covalent inhibitors for HIV-1 reverse transcriptase (RT). In this application, two separate pre-reactive groups were attached to a natural RT ligand, deoxynucleoside triphosphate (dTTP). Upon binding of both dTTP analogs in the RT active site, the pre-reactive groups are brought into the proper proximity and react with each other forming an intermediate that subsequently reacts with an amino acid side chain from the RT. This leads to covalent modification of
RT, and inhibition of its DNA polymerase activity. This concept was tested in vitro using dTTP analogs containing pre-reactive groups derived from β-lactamase inhibitors clavulanic acid (CA) and sulbactam (SB). Importantly, our in vitro assays show that CA based inhibitors are more potent than zidovudine (AZT), a representative of the dominant class of RT inhibitors currently used in anti-HIV therapy. Furthermore, molecular dynamics simulations predict that complexes of RT with these analogs are stable, and point to possible reaction mechanisms. The inhibitors described in this work may serve as the basis for the development of the first covalent inhibitors for RT. Moreover, the pre-reactive groups used in this study can be used to design covalent inhibitors for other targets by attaching them to different ligands. Overall, the work presented herein establishes the binary approach as a straightforward way to develop new probes to selectively recognize nucleic acids and proteins.

Committee: Dmitry Kolpashchikov (Chair), William Self, Debopam Chakrabarti, and Eda Koculi

Graduated Spring 2015
Chemical Analysis, Databasing, and Statistical Analysis of Smokeless Powders for Forensic Application

DANA-MARIE DENNIS
Chemistry PhD

Smokeless powders are a set of energetic materials, known as low explosives, which are typically utilized for reloading ammunition. There are three types which differ in their primary energetic materials; where single base powders contain nitrocellulose as their primary energetic material, double and triple base powders contain nitroglycerin in addition to nitrocellulose, and triple base powders also contain nitroguanidine. Additional organic compounds, while not proprietary to specific manufacturers, are added to the powders in varied ratios during the manufacturing process to optimize the ballistic performance of the powders. The additional compounds function as stabilizers, plasticizers, flash suppressants, deterrents, and opacifiers. Of the three smokeless powder types, single and double base powders are commercially available, and have been heavily utilized in the manufacture of improvised explosive devices.

Forensic smokeless powder samples are currently analyzed using multiple analytical techniques. Combined microscopic, macroscopic, and instrumental techniques are used to evaluate the sample, and the information obtained is used to generate a list of potential distributors. Gas chromatography – mass spectrometry (GC-MS) is arguably the most useful of the instrumental techniques since it distinguishes single and double base powders, and provides additional information about the relative ratios of all the analytes present in the sample. However, forensic smokeless powder samples are still limited to being classified as either single or double base powders, based on the absence or presence of nitroglycerin, respectively. In this work, the goal was to develop statistically valid classes, beyond the single and double base designations, based on multiple organic compounds which are commonly encountered in commercial smokeless powders. Several chemometric techniques were applied to smokeless powder GC-MS data for determination of the classes, and for assignment of test samples to these novel classes. The total ion spectrum (TIS), which is calculated from the GC-MS data for each sample, is obtained by summing the intensities for each mass-to-charge ($m/z$) ratio across the entire chromatographic profile.
A TIS matrix comprising data for 726 smokeless powder samples was subject to agglomerative hierarchical cluster (AHC) analysis, and six distinct classes were identified. Within each class, a single m/z ratio had the highest intensity for the majority of samples, though the m/z ratio was not always unique to the specific class. Based on these observations, a new classification method known as the Intense Ion Rule (IIR) was developed and used for the assignment of test samples to the AHC designated classes.

Discriminant models were developed for assignment of test samples to the AHC designated classes using k-Nearest Neighbors (kNN) and linear and quadratic discriminant analyses (LDA and QDA, respectively). Each of the models were optimized using leave-one-out (LOO) and leave-group-out (LGO) cross-validation, and the performance of the models was evaluated by calculating correct classification rates for assignment of the cross-validation (CV) samples to the AHC designated classes. The optimized models were utilized to assign test samples to the AHC designated classes. Overall, the QDA LGO model achieved the highest correct classification rates for assignment of both the CV samples and the test samples to the AHC designated classes.

In forensic application, the goal of an explosives analyst is to ascertain the manufacturer of a smokeless powder sample. In addition, knowledge about the probability of a forensic sample being produced by a specific manufacturer could potentially decrease the time invested by an analyst during investigation by providing a shorter list of potential manufacturers. In this work, Bayes’ Theorem and Bayesian Networks were investigated as an additional tool to be utilized in forensic casework. Bayesian Networks were generated and used to calculate posterior probabilities of a test sample belonging to specific manufacturers. The networks were designed to include manufacturer controlled powder characteristics such as shape, color, and dimension; as well as, the relative intensities of the class associated ions determined from cluster analysis. Samples were predicted to belong to a manufacturer based on the highest posterior probability. Overall percent correct rates were determined by calculating the percentage of correct predictions; that is, where the known and predicted manufacturer were the same. The initial overall percent correct rate was 66%. The dimensions of the smokeless powders were added to the network as average diameter and
average length nodes. Addition of average diameter and length resulted in an overall prediction rate of 70%.

Committee: Michael Sigman (Chair), Andres Campiglia, Cherie Yestrebsky, Barry Fookes, and Liqiang Ni

Graduated Summer 2015
π-Conjugated systems have been the focus of study in recent years in order to understand their charge transport and optical properties for use in organic electronic devices, fluorescence bioimaging, sensors, and 3D optical data storage (ODS), among others. As a result, several molecular building blocks have been designed, allowing new frontiers to be realized. While various successful building blocks have been fine-tuned at both the electronic and molecular structure level to provide advanced photophysical and optoelectronic characteristics, the azulene framework has been under-appreciated despite its unique electronic and optical properties. Among several attributes, azulenes are vibrant blue naturally occurring hydrocarbons that exhibit large dipolar character, coupled with stimuli-responsive behavior in acidic environments. Additionally, the non-toxic nature and the accompanying eco-friendly feature of some azulenes, namely guaiazulene, may set the stage to further explore a more “green” route towards photonic and conductive materials.

The first part of this dissertation focuses on exploiting guaiazulene as a natural building block for the synthesis of chromophores with varying stimuli-responsiveness. Results described in Chapter 1 show that extending the conjugation of guaiazulene through its seven-membered ring methyl group with aromatic substituents dramatically impacts the optical properties of the guaiazulenium carbocation. Study of these π-stabilized tropilium ions enabled establishing photophysical structure-property trends for guaiazulene-terminated π-conjugated analogs under acidic conditions, including absorption, emission, quantum yield, and optical band gap patterns. These results were exploited in the design of a photosensitive polymeric system with potential application in the field of three dimensional (3D) optical data storage (ODS).

Chapter 2 describes the use of guaiazulene reactive sites (C-3 and C-4 methyl group) to generate a series of cyclopenta[ε]heptalenes that exhibit strong stimuli-responsive behavior. The approach presents a versatile route that allows for various substrates to be incorporated into the resulting
cyclopenta[ef]heptalenes, especially after optimization that led to devising a one-pot reaction toward such tricyclic systems. Examining the UV-vis absorption profiles in neutral and acidic media showed that the extension of conjugation at C(4) of the cyclopenta[ef]heptalene skeleton results in longer absorption maxima and smaller optical energy gaps. Additionally, it was concluded that these systems act as sensitizers of a UV-activated (< 300 nm) photoacid generator (PAG), via intermolecular photoinduced electron transfer (PeT), upon which the PAG undergoes photodecomposition resulting in the generation of acid.

In a related study, the guaiazulene methyl group at C-4 was employed to study the linear and nonlinear optical properties of 4-styrylguaiazulenes, having the same π-donor with varying π-spacer. It was realized that the conjugation length correlates with the extent of bathochromic shift of the protonated species. On the other hand, a trend of decreasing quantum yield was established for this set of 4-styrylguaiazulenes, which can be explained by the increasingly higher degree of flexibility.

The second part of this dissertation presents a comprehensive investigation of the linear photophysical, photochemical, and nonlinear optical properties of diketopyrrolopyrrole (DPP)-based derivatives, including two-photon absorption (2PA), femtosecond transient absorption, stimulated emission spectroscopy, and superfluorescence phenomena. The synthetic feasibility, ease of modification, outstanding robustness, and attractive spectroscopic properties of DPPs have motivated their study for fluorescence microscopy applications, concluding that the prepared DPP’s are potentially suitable chromophores for high resolution stimulated emission depletion (STED) microscopy.

Committee: Kevin Belfield (Chair), Andres Campiglia, Yu Yuan, Shengli Zou, and Zixi Cheng

Graduated Spring 2015
Synthesis of Fluorene-based Derivatives, Characterization of Optical Properties and Their Applications in Two-photon Fluorescence Imaging and Photocatalysis

GRACE GITHAIGA
Chemistry PhD

The two-photon absorption (2PA) phenomenon has attracted attention from various fields ranging from chemistry and biology to optics and engineering. Two of the common NLO applications in which organic materials have been used are three-dimensional (3D) fluorescence imaging and optical power limiting. Two-photon absorbing materials are, therefore, in great demand to meet the needs of emerging technologies. Organic molecules show great promise to meet this need as they can be customized through molecular engineering, and as the development of two-photon materials that suit practical application intensifies, so does research to meet this need. However, there remains some uncertainty in the particulars of design criteria for molecules with large 2PA cross sections at desired wavelengths, as such research to understand structure-property relationships is matter of significant importance. As a result, the full potential of 2PA materials has not been fully exploited. Several strategies to enhance the magnitude and tune the wavelength of 2PA have been reported for π-conjugated organic molecules. On this account, we have designed novel fluorophores using the fluorene moiety and modified it to tune the properties of the compounds.

Chapter 2 of this dissertation reports the successful application of fluorene-based compounds in photocatalysis; a process that involves the decomposition of organic compounds into environmentally friendly carbon dioxide and water attesting to the photostability of the fluorene moiety. A facile organic nanoparticle preparation method is reported in chapter 3 using the reprecipitation method, whose surface was then modified using a naturally occurring surfactant, Lecithin, and were then successfully used in fluorescence cell imaging. Chapter 4 reports the design and synthesis of a fluorene-based compound using an acceptor, s-indacene-1, 3, 5, 7(2H, 6H)-tetra one, or Janus Dione, a moiety that is relatively new and that has not been fully exploited despite its very attractive features. Owing to the hydrophobicity of this compound, notwithstanding its unprecedented 2PA cross section, it was not applicable in fluorescence cell imaging but
provided the tenets for the design of related derivative. This limitation was circumvented in the concluding chapter by tuning the compound’s hydrophilicity. The hydrophilic Janus dione probe was then used as envisioned for cell imaging as the dual prerequisites for fluorescence imaging probes; large 2PA cross sections and high fluorescence quantum yields were met.

Committee: Kevin Belfield (Chair), Pedro Patino Marin (Co-Chair), Karin Chumbimuni Torres, Shengli Zou, and Zixi Cheng

Graduated Spring 2015
Mass Spectral Studies to Investigate Butylbenzene Fragmentation Pathway and Pyrolysis Products

BALASUBRAMANIAM LINGAM
Chemistry PhD

In this dissertation research, two fundamental studies involving gas chromatography mass spectrometry of n-butylbenzene and pyrolysis products are presented. In the first study, fragmentation pathways of n-butylbenzene in quadrupole ion trap have been investigated. At low energy, product ion corresponding to m/z 92 and m/z 91 are formed via competitive parallel dissociation. Studies have also shown that at higher energy m/z 92 has sufficient internal energy to undergo further fragmentation yielding m/z 91 via consecutive dissociation. Thus in order to discern the fragmentation pathways of n-butylbenzene, the technique of two-dimensional correlation spectroscopy (2DCOS) was applied to the mass spectral data. Application of 2DCOS resulted in two 2D correlation spectra namely synchronous and asynchronous. A third spectra known as coherence spectra was obtained from the ration of asynchronous to synchronous correlation intensities. For the elucidation of n-butylbenzene fragmentation pathways, all the three spectra were utilized in this study. The second study in this dissertation involves investigation of pyrolysis products to aid in fire debris analysis. One of the major concerns in fire debris analysis is that pyrolysis products can mask the patterns of compounds of interest and make the chromatographic results interpretation extremely difficult. One of the approaches for investigating the formation of pyrolysis products is to subject the commonly found building materials to controlled heating in laboratory. In this study, new heating methodologies for controlled heating of substrates involving furnace, paint-cans and flat steel pans have been developed. The substrates used for investigating pyrolysis products were polystyrene, polyvinylchloride, polybutadiene, yellow-pine, nylon carpet and padding. Experiments were also performed to investigate the influence of hydrocarbons on the formation of pyrolysis.

Committee: Michael Sigman (Chair), Christian Clausen, Andres Campiglia, Delbert Miles, and Alfons Schulte

Graduated Spring 2015
Quantum Chemical Studies for the Engineering of Metal Organic Materials

HECTOR RIVERA JACQUEZ
Chemistry PhD

Metal Organic Materials (MOM) are composed of transition metal ions as connectors and organic ligands as linkers. MOMs have been found to have high porosity, catalytic, and optical properties. Here we study the gas adsorption, color change, and non-linear optical properties of MOMs. These properties can be predicted using theoretical methods, and the results may provide experimentalists with guidance for rational design and engineering of novel MOMs. The theory levels used include semi-empirical quantum mechanical calculations with the PM7 Hamiltonian and, Density Functional Theory (DFT) to predict the geometry and electronic structure of the ground state, and Time Dependent DFT (TD-DFT) to predict the excited states and the optical properties.

The molecular absorption capacity of aldoxime coordinated Zn(II) based MOMs (previously measured experimentally) is predicted by using PM7 Theory level. The 3D structures were optimized with and without host molecules inside the pores. The absorption capacity of these crystals was predicted to be 8H₂ or 3N₂ per unit cell. When going beyond this limit, the structural integrity of the bulk material becomes fractured and microcrystals are observed both experimentally and theoretically.

The linear absorption properties of Co(II) based complexes are known to change color when the coordination number is altered. In order to understand the mechanism of this color change TD-DFT methods are employed. The chromic behavior of the Co(II) based complexes studied was confirmed to be due to a chain in coordination number that resulted in lower metal to ligand distances. These distances destabilize the occupied metal d orbitals, and as a consequence of this, the metal to ligand transition energy is lowered enough to allow the crystals to absorb light at longer wavelengths.

Covalent organic frameworks (COFs) present an extension of MOM principles to the main group elements. The synthesis of ordered COFs is possible by using predesigned structures and carefully selecting the building blocks and their conditions for assembly. The crystals formed by
these systems often possess non-linear optical (NLO) properties. Second Harmonic Generation (SHG) is one of the most used optical processes. Currently, there is a great demand for materials with NLO optical properties to be used for optoelectronic, imaging, sensing, among other applications. DFT calculations can predict the second order hyperpolarizability $\chi^2$ and tensor components necessary to estimate NLO. These calculations for the $\chi^2$ were done with the use of the Berry’s finite field approach. An efficient material with high $\chi^2$ was designed and the resulting material was predicted to be nearly fivefold higher than the urea standard.

Two-photon absorption (2PA) is another NLO effect. Unlike SHG, it is not limited to acentric material and can be used development of in vivo bio-imaging agents for the brain. Pt(II) complexes with porphyrin derivatives are theoretically studied for that purpose. The mechanism of 2PA enhancement was identified. For the most efficient porphyrin, the large 2PA cross-section was found to be caused by a HOMO-LUMO+2 transition. This transition is strongly coupled to 1PA allowed Q-band HOMO-LUMO states by large transition dipoles. Alkyl carboxyl substituents delocalize the LUMO+2 orbital due to their strong $\pi$-acceptor effect, enhancing transition dipoles and lowering the 2PA transition to the desirable wavelengths range.

The mechanism 2PA cross-section enhancement of aminoxime and aldoxime ligands upon metal addition of is studied with TD-DFT methods. This mechanism of enhancement is found to be caused by the polarization of the ligand orbitals by the metal cation. After polarization an increase in ligand to ligand transition dipole moment. This enhancement of dipole moment is related to the increase in 2PA cross-sections.

Committee: Artem Masunov (Chair), Alexander Balaeff (Co-Chair), James Harper, Emily Heider, Shengli Zou, and William Kaden

Graduated Fall 2015
Integral Representations of Positive Linear Functionals

ANGELA SIPE
Mathematics PhD

In this dissertation we obtain integral representations for positive linear functionals on commutative algebras with involution and semigroups with involution. We prove Bochner and Plancherel type theorems for representations of positive functionals and show that, under some conditions, the Bochner and Plancherel representations are equivalent. We also consider the extension of positive linear functionals on a Banach algebra into a space of pseudoquotients and give under conditions in which the space of pseudoquotients can be identified with all Radon measures on the structure space. In the final chapter we consider a system of integrated Cauchy functional equations on a semigroup, which generalizes a result of Ressel and offers a different approach to the proof.

Committee: Piotr Mikusinski (Chair), Dragu Atanasiu (Co-Chair), Dorin Dutkay, Deguang Han, Junho Lee, Joseph Brennan, and Qun Huo

Graduated Spring 2015
An Exploratory Comparison of a Traditional and an Adaptive Instructional Approach for College Algebra

RYAN KASHA
Modeling and Simulation PhD

This research effort compared student learning gains and attitudinal changes through the implementation of two varying instructional approaches on the topic of functions in College Algebra. Attitudinal changes were measured based on the Attitude Towards Mathematics Inventory (ATMI). The ATMI also provided four sub-scales scores for self-confidence, value of learning, enjoyment, and motivation. Furthermore, this research explored and compared relationships between students' level of mastery and their actual level of learning.

This study implemented a quasi-experimental research design using a sample that consisted of 56 College Algebra students in a public, state college in Florida. The sample was enrolled in one of two College Algebra sections, in which one section followed a self-adaptive instructional approach using ALEKS (Assessment and Learning in Knowledge Space) and the other section followed a traditional approach using MyMathLab. Learning gains in each class were measured as the difference between the pre-test and post-test scores on the topic of functions in College Algebra. Attitude changes in each class were measured as the difference between the holistic scores on the ATMI, as well as each of the four sub-scale scores, which was administered once in the beginning of the semester and again after the unit of functions, approximately eight weeks into the course. Utilizing an independent t-test, results indicated that there was not a significant difference in actual learning gains for the compared instructional approaches. Additionally, independent t-test results indicated that there was not a statistical difference for attitude change holistically and on each of the four sub-scales for the compared instructional approaches. However, correlational analyses revealed a strong relationship between students' level of mastery learning and their actual learning level for each class with the self-adaptive instructional approach having a stronger correlation than the non-adaptive section, as measured by an r-to-z Fisher transformation test. The results of this study indicate that the self-adaptive instructional approach using ALEKS could more
accurately report students’ true level of learning compared to a non-adaptive instructional approach.

Overall, this study found the compared instructional approaches to be equivalent in terms of learning and effect on students’ attitude. While not statistically different, the results of this study have implications for math educators, instructional designers, and software developers. For example, a non-adaptive instructional approach can be equivalent to a self-adaptive instructional approach in terms of learning with appropriate planning and design. Future recommendations include further case studies of self-adaptive technology in developmental and college mathematics in other modalities such as hybrid or on-line courses. Also, this study should be replicated on a larger scale with other self-adaptive math software in addition to focusing on other student populations, such as K-12. There is much potential for intelligent tutoring to supplement different instructional approaches, but should not be viewed as a replacement for teacher-to-student interactions.

Committee: John Kincaid (Chair), Rudolf Wiegand, Richard Hartshorne, and Cliff Morris

Graduated Fall 2015
Team Interaction Dynamics during Collaborative Problem Solving

TRAVIS WILTSHIRE
Modeling and Simulation PhD

This dissertation contributes an enhanced understanding of team cognition, in general, and collaborative problem solving (CPS), specifically, through an integration of methods that measure team interaction dynamics and knowledge building as it occurs during a complex CPS task. The need for better understanding CPS has risen in prominence as many organizations have increasingly worked to address complex problems requiring the combination of diverse sets of individual expertise to achieve solutions for novel problems. Towards this end, the present research drew from theoretical and empirical work on Macrocognition in Teams that describes the knowledge coordination arising from team communications during CPS. It built from this by incorporating the study of team interaction during complex collaborative cognition. Interaction between team members in such contexts has proven to be inherently dynamic and exhibiting nonlinear patterns not accounted for by extant research methods. To redress this gap, the present research drew from work in cognitive science designed to study social and team interaction as a nonlinear dynamical system. CPS was examined by studying knowledge building and interaction processes of 43 dyads working on NASA’s Moonbase Alpha simulation, a CPS task. Both non-verbal and verbal interaction dynamics were examined. Specifically, frame-differencing, an automated video analysis technique, was used to capture the bodily movements of participants and content coding was applied to the teams’ communications to characterize their CPS processes. A combination of linear (i.e., multiple regression, t-test, and time-lagged cross-correlation analysis), as well as nonlinear analytic techniques (i.e., recurrence quantification analysis; RQA) were applied. In terms of the predicted interaction dynamics, it was hypothesized that teams would exhibit synchronization in their bodily movements and complementarity in their communications and further, that teams more strongly exhibiting these forms of coordination will produce better problem solving outcomes. Results showed that teams did exhibit a pattern of bodily movements that could be characterized as synchronized, but higher synchronization was not systematically related to performance. Further, results showed that teams did exhibit communicative interaction that was complementary, but this was not predictive of better problem solving performance. Several exploratory
research questions were proposed as a way of refining the application of these techniques to the investigation of CPS. Results showed that semantic code-based communications time-series and %REC and ENTROPY recurrence-based measures were most sensitive to differences in performance. Overall, this dissertation adds to the scientific body of knowledge by advancing theory and empirical knowledge on the forms of verbal and non-verbal team interaction during CPS, but future work remains to be conducted to identify the relationship between interaction dynamics and CPS performance.

Committee: Stephen Fiore (Chair), Florian Jentsch, Eduardo Salas, and Rudolf Wiegand

Graduated Summer 2015
Translocation of a Semiflexible Polymer through a Nanopore

RAMESH ADHIKARI
Physics PhD

The transport of a biomolecule through a nanopore occurs in many biological functions such as, DNA or RNA transport across nuclear pores and the translocation of proteins across the eukaryotic endoplasmic reticulum. In addition to the biological processes, it has potential applications in technology such as, drug delivery, gene therapy and single molecule sensing. The DNA translocation through a synthetic nanopore device is considered as the basis for cheap and fast sequencing technology. Motivated by the experimental advances, many theoretical models have been developed. In this thesis, we explore the dynamics of driven translocation of a semiflexible polymer through a nanopore in two dimensions (2D) using Langevin dynamics (LD) simulation. By carrying out extensive simulation as a function of different parameters such as, driving force, length and rigidity of the chain, viscosity of the solvent, and diameter of the nanopore, we provide a detailed description of the translocation process.

Polymer translocation through a nanopore is a stochastic process. The statistical average of the time period and its distribution while the first monomer enters the pore from the cis side until the last monomer exits towards the trans side is called the mean first passage time (MFPT) or simply the translocation time \( \langle T \rangle \) that explains the dynamics of polymer translocation. We found the power law scaling of the MFPT with the chain rigidity. We explain this scaling law using the non-equilibrium tension propagation (TP) theory proposed by Sakaue (Phys. Rev. E 76, 021803 (2007)) and its modifications to Brownian dynamics tension propagation (BDTP) theory (Phys. Rev. E 85 051803 (2012)), originally developed for a fully flexible polymer. The BDTP theory, using the residence time of each monomer at the pore, introduced a time scale on which the tension front propagates along the chain backbone and hits the last monomer in the cis compartment, a tension propagation time \( t_{tp} \). Our simulation data for \( t_{tp} \) obtained by monitoring the dynamics of last monomer validate the TP theory for a semi flexible polymer (J. Chem. Phys. 138, 204909 (2013)). We have showed that the \( t_{tp} \) increases (decreases) as a function of chain rigidity (driving force) but the ratio \( t_{tp} / \langle T \rangle \) decreases (remains independent).
We have also studied the translocation of a heterogeneous chain mimicking a rod-coil conformation (as often occurs in partially melted dsDNA or proteins). Specifically, we studied dependence of MFPT on the free parameters of the chain such as, alternate blocks of stiff and flexible segments of size \( m \) and \( n \), bending rigidity, the spring constant \( (k_p) \) which controls the bond elastic potential between the successive monomers and the repeat unit \( p \) (such that \( N = m_p n_p \)). We demonstrate that due to the change in entropic barrier and the inhomogeneous viscous drag on the chain backbone a variety of scenarios are possible amply manifested in the waiting time distribution of the translocating chain. These information can be deconvoluted to extract the mechanical properties of the chain at various length scales and thus can be used to nanopore based methods to probe bio-molecules, such as partially melted DNA, and proteins.

To explore the effect of solvent on the translocation process, we have calculated the MFPT as a function of the solvent viscosity. At low solvent-viscosity, a stiffer chain translocates faster than a flexible chain of the same length but the order of translocation speed is reversed in the high viscosity regime. We observe a non-monotonic dependence of \( \langle T \rangle \) on \( \gamma \) in the low viscosity regime. The scaling laws developed for the translocation at high viscosity do not fit for the system consisting the solvent of low viscosity. However, we have observed that the translocation time at low solvent-viscosity still remains sensitive to the parameters such as, \( k_p, N, F \) and \( P_d \).

Attractive binding particles (BPs) present in the trans compartment accelerate the threading process in two ways: (i) reducing the back-sliding of the translocated monomer and (ii) providing the pulling force towards the translocation direction. We observe that for certain binding strength and concentration of the BPs, the translocation is faster than the ideal ratcheting condition as elucidated by Simon, Peskin, and Oster (Proc. Natl. Acad. Sci. U.S.A. 89, 3770 (1992)). The asymmetry produced by the BPs at the trans side leads to similarities of this process to that of a driven translocation with an applied force inside the pore manifested in various physical quantities. We provide scaling relations for the force experienced by the translocating chain as well as for the scaled MFPT. Based on the analysis of our simulation data we provide plausible arguments how scaling theory of driven translocation can be generalized for such directed diffusion process by replacing the externally applied force with an effective force.
We believe the information gained from these studies will be useful for designing nanopore based devices of sequencing as well as understanding the physics of biomolecular transport in various cases.

Committee: Aniket Bhattacharya (Chair), Bo Chen, Viatcheslav Kokouline, and Florencio Hernandez

Graduated Fall 2015
Nanoelectronic Devices Using Carbon Nanotubes and Graphene Electrodes: Fabrication and Electronic Transport Investigations

NARAE KANG
Physics PhD

Fabrication of high-performance electronic devices using the novel semiconductors is essential for developing future electronics which can be applicable in large-area, flexible and transparent displays, sensors and solar cells. One of the major bottlenecks in the fabrication of high-performance devices is a large interfacial barrier formation at metal/semiconductor interface originated from Schottky barrier and interfacial dipole barrier which causes inefficient charge injection at the interface. Therefore, having a favorable contact at electrode/semiconductor is highly desirable for high-performance devices fabrication.

In this dissertation, the fabrication of nanoelectronic devices and investigation of their transport properties using carbon nanotubes (CNTs) and graphene as electrode materials will be shown. I investigated two types of devices using (i) semiconducting CNTs, and (ii) organic semiconductors (OSC). In the first part of this thesis, I will demonstrate the fabrication of high-performance solution-processed highly enriched (99%) semiconducting CNT thin film transistors (s-CNT TFTs) using densely aligned arrays of metallic CNTs (m-CNTs) for source/drain electrodes. From the electronic transport measurements at room temperature, significant improvements of field-effect mobility, on-conductance, transconductance and current on/off ratio for m-CNT/s-CNT devices were found compared to control palladium (Pd) contacted s-CNT devices. From the temperature dependent transport investigation, a lower Schottky barrier height for the m-CNT/s-CNT devices was found compared to the devices with control metal electrodes. The enhanced device performance can be attributed to the unique device geometry as well as strong π-π interaction at m-CNT/s-CNT interfaces. In addition, I also investigated s-CNT TFTs using reduced graphene oxide (RGO) electrodes.

In the second part of my thesis, I will demonstrate high-performance organic field-effect transistors (OFETs) using different types of graphene electrodes.
I show that the performance of OFETs with pentacene as OSC and RGO as electrode can be continuously improved by increasing the carbon $sp^2$ fraction of RGO. The carbon $sp^2$ fractions of RGO were varied by controlling the reduction time. When compared to control Pd electrodes, the mobility of the OFETs shows an improvement of ~200% for 61% $sp^2$ fraction RGO, which further improves to ~500% for 80% RGO electrode. Similarly, I show that when the chemical vapor deposition (CVD) graphene film is used as electrodes in fabricating OFET, the better performance is observed in comparison to RGO electrodes. Our study suggests that, in addition to $\pi$-$\pi$ interaction at graphene/pentacene interface, the tunable electronic properties of graphene as electrode have a significant role in OFETs performance. For a fundamental understanding of the interface, we fabricated short-channel OFETs with sub-100nm channel length using graphene electrode. From the low temperature electronic transport measurements, a lower charge injection barrier was found compared to control metal electrode. The detailed investigations reported in this thesis clearly indicated that the use of CNT and graphene as electrodes can improve the performance of future nanoelectronic devices.

Committee: Saiful Khondaker (Chair), Michael Leuenberger, Lee Chow, and Lei Zhai

Graduated Spring 2015
This dissertation reports investigations into materials for, and applications of, infrared surface plasmon polaritons (SPP). SPPs are inhomogeneous electromagnetic waves that are bound to the surface of a conductor. Tight confinement of electromagnetic energy, the primary virtue of SPPs for so-called “plasmonic” applications, requires plasma frequencies for the conductor near the intended infrared operational frequencies. This requires carrier concentrations that are much less than those of usual metals such as gold and silver. I have investigated the optical properties and SPP excitation resonances of two materials having infrared plasma frequencies, namely the semimetal bismuth and the transparent conducting fluorine-doped tin-oxide (FTO). The complex permittivity spectra for evaporated films of Bi were found to be distinctly different than earlier reports for crystal or polycrystalline films, and SPP excitation resonances on Bi-coated gratings were found to be disappointingly broad. Permittivity spectra for chemical spray deposited FTO were obtained to long-wave IR wavelengths for the first time, and nano-crystalline FTO-coated silicon lamellar gratings show remarkable conformity. SPP excitation resonances for FTO are more promising than for Bi. Thus, FTO appears to be a promising SPP host for infrared plasmonics, e.g. a planer waveguide plasmonic spectral sensor, whose design was elaborated and investigated as part of my research and which requires SPP-host coating on deep vertical side walls of a trench-like analyte interaction region. Additionally, FTO may serve as a useful conducting oxide for a near-IR plasmonic spectral imager that I have investigated theoretically.

Committee: Robert Peale (Chair), Masa Ishigami, Winston Schoenfeld, Walter Buchwald, and Reza Abdolvand

Graduated Summer 2015
Resistive Pulse Study of Vesicles and Liposomes

YUQING LIN
Physics PhD

In this work, the properties of the liposomes, the artificially created vesicles by various methods, are explored by a resistive pulse method using micropipettes. The fact that vesicles are fundamental in the wide range of functionalities they fulfill as organelles strengthen the desire of understanding the properties of them. The motivation of this work comes from the significant roles that liposomes play in the development of targeted drug delivery systems. Among other significant variables, the size of liposomes is found to be one of the dominating parameters in liposome based drug delivery, and the correlation between liposome size and delivery efficiency is discussed. To help improving the size evaluation ability, a few mainstream methods for liposome size detection and measurements are reviewed. As a reliable and accessible alternative method for liposomes detection, the resistive pulse method is introduced and the measurement on liposomes size change upon pH gradient was performed using this method. With our current liposome composition, we found the size increases as environmental pH increases. Further investigation is performed with vesicular pH=6, 7, and 8, respectively. Lastly, the stability of the small unilamellar vesicles (SUV) was studied via resistive pulse method, by monitoring the size change of 50nm liposomes as function of time. A significant size change in freshly prepared 50nm liposomes is recorded. This information will provide invaluable knowledge for targeting tumor with tight tissues, where small size liposomes are needed.

Committee: Lee Chow (Chair), Alfons Schulte, Suren Tatulian, and Jiann-Shiun Yuan

Graduated Summer 2015
Selective Electro-magnetic Absorbers Based on Metal-dielectric-metal Thin-film Cavities

JANARDAN NATH
Physics PhD

Efficient absorption of light is required for a large number of applications such as thermo-photovoltaics, thermal imaging, bio-sensing, thermal emitters, astronomy, and stealth technology. Strong light absorbers found in nature with high intrinsic losses such as carbon black, metal-black, and carbon nano-tubes etc. are bulky, not design-tunable and are hard to pattern for micro- and nano-devices. We developed thin-film, high performance absorbers in the visible, near-, mid-, long-wave, and far-IR region based on a 3 layer metal-dielectric-metal (MDM) structure.

We fabricated a 3-layer MDM absorber with large band-widths in the visible and near IR spectral range without any lithographic patterning. This was the first demonstration in the optical range of the Salisbury Screen, which was originally invented for radar absorption. A Fabry-Perot cavity model depending on the thickness of the dielectric, but also the effective permittivity of the semi-transparent top metal gives calculated spectra that agree well with experiment.

Secondly, we fabricated long-wave IR and far-IR MDM absorbers comprising surface patterns of periodic metal squares on the dielectric layer. Strong absorption in multiple bands were obtained, and these depended weakly on polarization and angle of incidence. Though such absorbers had been extensively studied by electrodynamic simulations and experiment in the visible to far-R regions, there existed no analytic model that could accurately predict the wavelengths of the multiple resonances. We developed a theoretical model for these absorbers based on standingwave resonances, which accurately predicts resonance wavelengths for experiment and simulation for the first time. Unlike metamaterial theories our model does not depend on the periodicity of the squares but only on their lateral...
dimension and the thickness of the dielectric. This feature is confirmed by synchrotron-based IR spectral imaging microscopy of single isolated squares.

Committee: Robert Peale (Chair), Masa Ishigami, Leonid Chernyak, and Konstantin Vodopyanov

Graduated Summer 2015
Electromechanical Lifting Actuation of a MEMS Cantilever and Nano-scale Analysis of Diffusion in Semiconductor Device Dielectrics

IMEN REZADAD

Physics PhD

This dissertation presents experimental and theoretical studies of physical phenomena in micro- and nano-electronic devices. Firstly, a novel and unproven means of electromechanical actuation in a micro-electromechanical system (MEMS) cantilever was investigated. In nearly all MEMS devices, electric forces cause suspended components to move toward the substrate. I demonstrated a design with the unusual and potentially very useful property of having a suspended MEMS cantilever lift away from the substrate. The effect was observed by optical micro-videography, by electrical sensing, and it was quantified by optical interferometry. The results agree with predictions of analytic and numerical calculations. One potential application is infrared sensing in which absorbed radiation changes the temperature of the cantilever, changing the duty cycle of an electrically-driven, repetitively closing micro-relay.

Secondly, ultra-thin high-k gate dielectric layers in two 22 nm technology node semiconductor devices were studied. The purpose of the investigation was to characterize the morphology and composition of these layers as a means to verify whether the transmission electron microscope (TEM) with energy dispersive spectroscopy (EDS) could sufficiently resolve the atomic diffusion at such small length scales. Results of analytic and Monte-Carlo numerical calculations were compared to empirical data to validate the ongoing viability of TEM EDS as a tool for nanoscale characterization of semiconductor devices in an era where transistor dimensions will soon be less than 10 nm.

Committee: Robert Peale (Chair), Enrique Del Barco, Laurene Tetard, and Brenda Prenitzer

Graduated Summer 2015
Vanadium Oxide Microbolometers with Patterned Gold Black or Plasmonic Resonant Absorbers

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EVAN SMITH  
Physics PhD

High sensitivity uncooled microbolometers are necessary to meet the needs of the next generation of infrared detectors, which seek low power consumption and production cost without sacrificing performance. Presented here is the design, fabrication, and characterization of a microbolometer with responsivity enhanced by novel highly absorptive coatings. The device utilizes a gold-doped vanadium oxide film in a standard air bridge design. Performance estimations are calculated from current theory, and efforts to maximize signal to noise ratio are shown and evaluated. Most notably, presented are the experimental results and analysis from the integration of two different absorptive coatings: a patterned gold black film and a plasmonic resonant structure.

Infrared-absorbing gold black was selectively patterned onto the active surfaces of the detector. Patterning by metal lift-off relies on protection of the fragile gold black with an evaporated oxide, which preserves gold black’s near unity absorptance. This patterned gold black also survives the dry-etch removal of the sacrificial polyimide used to fabricate the air-bridge bolometers. Infrared responsivity is improved 70% for mid-wave IR and 22% for long-wave IR. The increase in the thermal time constant caused by the additional mass of gold black is a modest 15%. However, this film is sensitive to thermal processing; experimental results indicate a decrease in absorptance upon device heating.

Sub-wavelength resonant structures designed for long-wave infrared (LWIR) absorption have also been investigated. Dispersion of the dielectric refractive index provides for multiple overlapping resonances that span the 8-12 µm LWIR wavelength band, a broader range than can be achieved using the usual resonance quarter-wave cavity engineered into the air-bridge structures. Experimental measurements show an increase in responsivity of 96% for mid-wave IR and 48% for long-wave IR, while thermal response time only increases by 16% due to the increased heat capacity. The resonant structures are not as susceptible to thermal processing as are the gold black
films. This work suggests that plasmonic resonant structures can be an ideal method to improve detector performance for microbolometers.

Committee: Robert Peale (Chair), Saiful Khondaker, Adrienne Dove, and Glenn Boreman

Graduated Fall 2015
Electronic Transport Properties of Carbon Nanotubes: The Impact of Atomic Charged Impurities

RYUICHI TSUCHIKAWA
Physics PhD

Even changing one atom in nanoscale materials is expected to alter their properties due to their small physical sizes. Such sensitivity can be utilized to modify materials’ properties from bottom up and is essential for the utility of nanoscale materials. As such, the impact of extrinsic atomic adsorbates was measured on pristine graphene and a network of carbon nanotubes using atomic hydrogen, cesium atoms, and dye molecules. In order to further quantify such an atomic influence, the resistance induced by a single potassium atom on metallic and semiconducting carbon nanotubes was measured for the first time. Carbon nanotubes are sensitive to adsorbates due to their high surface-to-volume ratio. The resistance arising from the presence of extrinsic impurity atoms depends on the types of nanotubes. Metallic carbon nanotubes are resilient to a long-ranged, Coulomb-like potential, whereas semiconducting carbon nanotubes are susceptible to these impurities. The difference in the scattering strength originates from the chirality of carbon nanotubes, which defines their unique electronic properties. This difference had not directly measured experimentally because of the issue of contact resistance, the difficulty of chirality identification, and the uncertainty in the number of impurity atoms introduced on carbon nanotubes.

We synthesized atomically clean, long (>100 µm) carbon nanotubes, and their chirality was identified by Rayleigh scattering spectroscopy. We introduced potassium atoms on the nanotubes to impose a long-range, Coulomb potential and measured the change in resistivity, excluding the contact resistance, by plotting the resistance as a function of the carbon nanotube length. The flux of potassium atoms coming onto the nanotubes was monitored by quartz crystal microbalance, and the scattering strength of a single potassium atom was deduced from the change in resistivity and the density of potassium atoms on the nanotubes. We found that the scattering strength of potassium atoms on semiconducting nanotubes depends on the charge carrier type (holes or electrons). Metallic nanotubes were found to be less affected by the presence of potassium atoms than semiconducting
nanotubes, but the scattering strength showed a large dependence on Fermi energy. These experimental results were compared to theoretical simulations, and we found a good agreement with the experiments. Our findings provide crucial information for the application of carbon nanotubes for electronic devices, such as transistors and sensors.

Committee: Marsahir Ishigami (Chair), Eduardo Mucciolo, Robert Peale, and Artem Masunov

Graduated Spring 2015
Observations, Thermochemical Calculations, and Modeling of Exoplanetary Atmospheres

JASMINA BLECIC
Physics PhD - Planetary Sciences

This dissertation as a whole aims to provide the means to better understand hot-Jupiter planets through observing, performing thermochemical calculations, and modeling their atmospheres. We used Spitzer multi-wavelength secondary-eclipse observations to characterize planetary atmospheres. We chose targets with high signal-to-noise ratios, as their deep eclipses allow us to detect signatures of spectral features and assess planetary atmospheric structure and composition with greater certainty.

Chapter 1 gives a short introduction. Chapter 2 presents the Spitzer secondary-eclipse analysis and atmospheric characterization of WASP-14b. The decrease in flux when a planet passes behind its host star reveals the planet dayside thermal emission, which, in turn, tells us about the atmospheric temperature and pressure profiles and molecular abundances. WASP-14b is a highly irradiated, transiting hot Jupiter. By applying a Bayesian approach in the atmospheric analysis, we found an absence of thermal inversion contrary to theoretical predictions.

Chapter 3 describes the infrared observations of WASP-43b’s Spitzer secondary eclipses, data analysis, and atmospheric characterization. WASP-43b is one of the closest-orbiting hot Jupiters, orbiting one of the coolest stars with a hot Jupiter. This configuration provided one of the strongest signal-to-noise ratios. The atmospheric analysis ruled out a strong thermal inversion in the dayside atmosphere of WASP-43b and put a nominal upper limit on the day-night energy redistribution.

Chapter 4 presents an open-source Thermochemical Equilibrium Abundances (TEA) code and its application to several hot-Jupiter temperature and pressure models. TEA calculates the abundances of gaseous molecular species using the Gibbs free-energy minimization method within an iterative Lagrangian optimization scheme. The thermochemical equilibrium abundances obtained with TEA can be used to initialize atmospheric models of any planetary atmosphere. The code is written in
Python, in a modular fashion, and it is available to the community via http://github.com/dzesmin/TEA.

Chapter 5 presents my contributions to an open-source Bayesian Atmospheric Radiative Transfer (BART) code, and its application to WASP-43b. BART characterizes planetary atmospheres based on the observed spectroscopic information. It initializes a planetary atmospheric model, performs radiative-transfer calculations to produce models of planetary spectra, and using a statistical module compares models with observations. We describe the implementation of the initialization routines, the atmospheric profile generator, the eclipse module, the best-fit routines, and the contribution function module. We also present a comprehensive atmospheric analysis of all WASP-43b secondary-eclipse data obtained from the space- and ground-based observations using BART.

Committee: Joseph Harrington (Chair), Daniel Britt, Robert Peale, and Jonathan Fortney

Graduated Fall 2015
Characterizing Exoplanet Atmospheres: From Light-curve Observations to Radiative-Transfer Modeling

PATRICIO CUBILLOS VALLEJOS
Physics PhD - Planetary Sciences

Multi-wavelength transit and secondary-eclipse light-curve observations are some of the most powerful techniques to probe the thermo-chemical properties of exoplanets. Although the large planet-to-star brightness contrast and few available spectral bands produce data with low signal-to-noise ratios, a Bayesian approach can robustly reveal what constraints we can set, without over-interpreting the data. Here I performed an end-to-end analysis of transiting exoplanet data. I analyzed space-telescope data for three planets to characterize their atmospheres and refine their orbits, investigated correlated noise estimators, and contributed to the development of the respective data-analysis pipelines. Chapters 2 and 3 describe the Photometry for Orbits, Eclipses and Transits (POET) pipeline to model Spitzer Space Telescope light curves. I analyzed secondary-eclipse observations of the Jupiter-sized planets WASP-8b and TrES-1, determining their day-side thermal emission in the infrared spectrum. The emission data of WASP-8b indicated no thermal inversion, and an anomalously high 3.6 micron brightness. Standard solar-abundance models, with or without a thermal inversion, can fit the thermal emission from TrES-1 well. Chapter 4 describes the most commonly used correlated-noise estimators for exoplanet light-curve modeling, and assesses their applicability and limitations to estimate parameters uncertainties. I show that the residual-permutation method is unsound for estimating parameter uncertainties. The time-averaging and the wavelet-based likelihood methods improve the uncertainty estimations, being within 20 - 50% of the expected value. Chapter 5 describes the open-source Bayesian Atmospheric Radiative Transfer (BART) code to characterize exoplanet atmospheres. BART combines a thermochemical-equilibrium code, a one-dimensional line-by-line radiative-transfer code, and the Multi-core Markov-chain Monte Carlo statistical module to constrains the atmospheric temperature and chemical-abundance profiles of exoplanets. I applied the BART code to the Hubble and Spitzer Space Telescope transit observations of the Neptune-sized planet...
HAT-P-11b. BART finds an atmosphere enhanced in heavy elements, constraining the water abundance to 100 times that of the solar abundance.

Committee: Joseph Harrington (Chair), Eduardo Mucciolo, Humberto Campins, and Jonathan Fortney

Graduated Fall 2015
We investigate the spectra of asteroids at near- and mid-infrared wavelengths. In 2010 and 2011 we reported the detection of 3 µm and 3.2-3.6 µm signatures on (24) Themis and (65) Cybele indicative of water-ice and complex organics [1] [2] [3]. We further probed other primitive asteroids in the Cybele dynamical group and Themis family, finding diversity in the shape of their 3 µm [4] [5] [6] and 10 µm spectral features [4]. These differences indicated mineralogical and compositional variations within these asteroid populations. Also in the mid-infrared region we studied a larger population of asteroids belonging to the Bus C, D, and S taxonomic classes to understand the relationship between any mineralogy and hydration inferred in the visible and near-infrared with the shape, strength, and slope of the 10 µm emission. We have discovered that at least 3 of the main Bus taxonomic groups (Cs, Ds, and Ss as defined by their visible spectra) clearly cluster into 3 statistically distinct groups based on their 8-13 µm spectra. Additionally we have attempted to simulate in a laboratory the possible organic compounds we have detected on two asteroids, using various mixtures containing aromatic and aliphatic hydrocarbons. We find that asteroid (24) Themis and (65) Cybele have $\tau_{\text{CH}_2}/\tau_{\text{CH}_3}$ and $N_{\text{CH}_2}/N_{\text{CH}_3}$ ratios similar to our 3-methylpentane, propane, and hexane residues, suggesting that the organics on these asteroids may be short chained and/or highly branched. The $\tau_{\text{CH}_2}/\tau_{\text{CH}_3}$ and $N_{\text{CH}_2}/N_{\text{CH}_3}$ for asteroid (24) Themis are most consistent with the DISM, and some carbonaceous chondrites. The band centers of the C-H stretch absorptions indicate that both asteroids may have aliphatic carriers chemically bonded to electronegative groups (i.e. aromatics), and some that are not. We also detect a 3.45 µm feature in the spectra of both asteroids that is present in several dense molecular clouds. Our results suggest an interstellar origin for the organics on (24) Themis, and likely (65) Cybele. The differences in the organics of Themis and Cybele
are likely related to variations in thermal processing, irradiation and/or formation region in the solar nebula.

Committee: Joshua Colwell (Chair), Yan Fernandez, Daniel Britt, and Michael Kelley

Graduated Spring 2015
The Bridging Technique: Crossing Over the Modality Shifting Effect

THOMAS ALICIA
Psychology PhD - Applied Experimental and Human Factors
Psychology

Operator responsiveness to critical alarm/alert display systems must rely on faster and safer behavioral responses in order to ensure mission success in complex environments such as the operator station of an Unmanned Aerial System (UAS). An important design consideration for effective UAS interfaces is how to map these critical alarm/alert display systems to an appropriate sensory modality (e.g., visual or auditory) (Sarter, 2006). For example, if an alarm is presented during a mission in a modality already highly taxed or overloaded, this can result in increased response time (RT), thereby decreasing operator performance (Wickens, 1976). To overcome this problem, system designers may allow the switching of the alarm display from a highly-taxied to a less-taxied modality (Stanney et al., 2004). However, this modality switch may produce a deleterious effect known as the Modality Shifting Effect (MSE) that erodes the expected performance gain (Spence & Driver, 1997). The goal of this research was to empirically examine a technique called bridging which allows the transitioning of a cautionary alarm display from one modality to another while simultaneously counteracting the Modality Shifting Effect.

Sixty-four participants were required to complete either a challenging visual or auditory task using a computer-based UAS simulation environment while responding to both visual and auditory alarms. An approach was selected which utilized two 1 (task modality) x 2 (switching technique) ANCOVAs and one 2 (modality) x 2 (technique) ANCOVA, using baseline auditory and visual RT as covariates, to examine differences in alarm response times when the alert modality was changed abruptly or with the bridging technique from a highly loaded sensory channel to an underloaded sensory channel. It was hypothesized that the bridging technique condition would show faster response times for a new unexpected modality versus the abrupt switching condition. The results indicated only a marginal decrease in response times for the auditory alerts and a larger yet not statistically significant effect for the visual alerts; results were also not statistically significant for the analysis collapsed across modality. Findings suggest that there may be some benefit of
the bridging technique on performance of alarm responsiveness, but further research is still needed before suggesting generalizable design guidelines for switching modalities which can apply in a variety of complex human-machine systems.

Committee: Mustapha Mouloua (Chair), Peter Hancock, James Szalma, and James Pharmer

Graduated Spring 2015
Tailoring Instruction to the Individual: Investigating the Utility of Trainee Aptitudes for Use in Adaptive Training

CARLA LANDSBERG
Psychology PhD - Applied Experimental and Human Factors Psychology

Computer-based training has become more prolific as the military and private business enterprises search for more efficient ways to deliver training. However, some methods of computer-based training are not more effective than traditional classroom methods. One technique that may be able to approximate the most effective form of training, one-on-one tutoring, is Adaptive Training (AT). AT techniques use instruction that is tailored to the learner in some way, and can adjust different training parameters such as difficulty, feedback, pace, and delivery mode.

There are many ways to adapt training to the learner, and in this study I explored adapting the feedback provided to trainees based on spatial ability in line with Cognitive Load Theory (CLT). In line with the CLT expertise reversal effect literature I hypothesized that for a spatial task, higher ability trainees would perform better when they were given less feedback. Alternately, I hypothesized that lower ability trainees would perform better during training when they were given more support via feedback. This study also compared two different adaptation approaches. The first approach, called the ATI approach, adapts feedback based on a premeasured ability. In this case, it was spatial ability. The second approach, called the Hybrid approach adapts initially based on ability, but then based on performance later in training. I hypothesized that participants who received Hybrid adaptive training would perform better.

The study employed a 2(spatial ability; high, low) X 2(feedback; matched, mismatched) X 2(approach; ATI, Hybrid) between-subjects design in which participants were randomly assigned to one of the eight conditions. Ninety-two participants completed a submarine-based periscope operator task that was visual and spatial in nature.

The results of the study did not support the use of CLT-derived adaptation based on spatial ability; contrary to what was hypothesized, higher ability
participants who received more feedback performed better than those who received less. Similarly, lower ability participants who received less feedback performed better than those who received more. While not significant, results suggested there may be some benefit to using the Hybrid approach, but more research is needed to determine the relative effectiveness of this approach.

Committee: Mustapha Mouloua (Chair), Clint Bowers, Mark Neider, and Wendi Van Buskirk

Graduated Spring 2015
Mental Rotation: Can Familiarity Alleviate the Effects of Complex Backgrounds?

ANTHONY SELKOWITZ
Psychology PhD - Applied Experimental and Human Factors Psychology

This dissertation investigated the effects of complex backgrounds on mental rotation. Stimulus familiarity and background familiarity were manipulated. It systematically explored how familiarizing participants to objects and complex backgrounds affects their performance on a mental rotation task involving complex backgrounds. This study had 113 participants recruited through the UCF Psychology SONA system. Participants were familiarized with a stimulus in a task where they were told to distinguish the stimulus from 3 other stimuli. A similar procedure was used to familiarize the backgrounds. The research design was a 2 stimulus familiarity (Familiarized with the Target Stimulus, not familiarized with the Target Stimulus) by 2 background familiarity (Familiarized with Target Background, not familiarized with Target Background) by 2 stimulus response condition (Target Stimulus, Non-Target Stimulus) by 3 background response condition (Target Background, Non-Target Background, Blank Background) by 12 degree of rotation (0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330) mixed design. The study utilized target stimulus and target background familiarity conditions as the between-subjects variables. Background, stimulus, and degree of rotation were within-subjects variables. The participants’ performance was measured using reaction time and percent of errors. Reaction time was computed using only the correct responses. After the familiarization task, participants engaged in a mental rotation task featuring stimuli and backgrounds that were present or not present in the familiarization task. A 2 (stimulus familiarization condition) by 2 (background familiarization condition) by 2 (stimulus response condition) by 3 (background response condition) by 12 (degree of rotation) mixed ANOVA was computed utilizing reaction time and percent of errors. Results suggest that familiarity with the Target Background had the largest effect on improving performance across response conditions. The results also suggest that familiarity with both the Target Stimulus and Target Background promoted inefficient mental rotation strategies which resulted in no significant differences between participants familiarized with neither the Target Stimulus nor the Target Background. Theoretical conclusions are drawn about stimulus familiarity and background familiarity. Future studies
should investigate the effects of long term familiarity practice on mental rotation and complex backgrounds.

Committee: Valerie Sims (Chair), Florian Jentsch, Matthew Chin, and Mason Cash

Graduated Fall 2015
Using Technology in the Treatment of Selective Mutism: The Incorporation of Mobile Applications

BRIAN BUNNELL
Psychology PhD - Clinical Psychology

Selective mutism (SM) is a diagnosis marked by withdrawal of speech in certain social situations. The treatment of SM is often a difficult and lengthy process and there are many barriers to successful intervention. Behavioral therapy is most effective in the treatment of SM and the addition of therapeutic activities such as games and mobile devices may provide distinct advantages to this treatment (i.e., decreased patient anxiety levels and more active engagement). The current investigation examined the utility of mobile applications during the behavioral treatment of SM as well as the effect of using mobile applications on child-reported and physiological indicators of anxious responding. Results indicated that children made remarkable treatment gains in just two treatment sessions (i.e., spoke to the clinician within 22 minutes of treatment and held five, five-minute conversations with additional adults during a second session) regardless of modality of delivery (using mobile applications, other activities, or reinforcement alone). Children shaped to speak with the inclusion of mobile applications reported less anxiety and exhibited decreased physiological anxious distress during treatment. The utility of mobile applications during the treatment of SM is discussed in addition to areas for future research (e.g., mobile-based treatment dissemination initiatives).

Committee: Deborah Beidel (Chair), Mark Rapport, Sandra Neer, and Gulnora Hundley

Graduated Summer 2015
Friendship and Informant Characteristics Associated with Agreement among Adolescent and Friend Ratings of Behavior Problems

BREA-ANNE LAUER
Psychology PhD - Clinical Psychology

Although teacher and parent informants often are used to gather information regarding adolescents’ emotional and behavioral functioning, research has suggested that agreement among these raters and adolescents’ self-ratings tends to be low to moderate. Given that friends typically play an important role in the lives of adolescents, the present study sought to determine the relative agreement amongst adolescent self-reports and those of their friends as well as factors that might impact this agreement. In particular, a sample of 207 culturally diverse high school students were matched based on perceived friendship closeness and asked to provide ratings of their own emotional and behavioral problems as well as that of an identified friend. Additionally, adolescents provided information regarding their friendship quality, previous exposure to psychopathology in others, and social competence as well as their endorsements for etiological attributions for friends’ behavior. Results revealed that adolescent self-ratings and those of their friends demonstrate high levels of agreement for both internalizing and externalizing problems. Further, raters’ emotional and behavioral problems were related inconsistently to rating agreement, whereas friendship quality and other rater characteristics (i.e., previous exposure, social competence) did not demonstrate a relationship. Additionally, friends tended to provide explanations for behavior problems that varied according to the type of behavior observed. Specifically, adolescents were more likely to provide explanations that were external in nature for internalizing symptoms, whereas explanations for externalizing symptoms were both internal and external. Overall, this study provided additional support for the utility of friend informants when ratings of adolescents’ emotional and behavioral problems are needed.

Committee: Kimberly Renk (Chair), Jeffrey Cassisi, Valerie Sims, and Anne Culp

Graduated Fall 2015
The Effect of Traumatic Brain Injury on Exposure Therapy in Veterans with Combat-related Posttraumatic Stress Disorder

KATHLEEN RAGSDALE
Psychology PhD - Clinical Psychology

Veterans of Operation Enduring Freedom, Operation Iraqi Freedom, and Operation New Dawn are presenting for treatment with high rates of combat-related posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI), spurring a need for clinical research on optimal treatment strategies. While exposure therapy has long been supported as an efficacious treatment for combat-related PTSD, some clinicians are hesitant to utilize this treatment for veterans with TBI history due to presumed cognitive deficits that may preclude successful engagement. The purpose of this study was to compare exposure therapy process variables in veterans with PTSD only and veterans with PTSD+TBI. Results suggest that individuals with PTSD+TBI engage successfully in exposure therapy, and do so no differently than individuals with PTSD only. Additional analyses indicated that regardless of TBI status, more severe PTSD was related to longer sessions, more sessions, and slower extinction rate during imaginal exposure. Finally, in a subset of participants, self-report of executive dysfunction did not impact exposure therapy process variables. Overall, findings indicate that exposure therapy should be the first-line treatment for combat-related PTSD regardless of presence of TBI history.

Committee: Deborah Beidel (Chair), Sandra Neer, Clint Bowers, and Liqiang Ni

Graduated Summer 2015
Can Mutual Trust Explain the Diversity-performance Relationship? A Meta-analysis

—

JENNIFER FEITOSA PEREIRA
Psychology PhD - Industrial and Organizational Psychology

Trust is gaining attention for its benefits to both teams and organizations as a whole (Fulmer & Gelfand, 2012). The difficulty of building it in comparison to the ease of destroying it calls for a deeper understanding of trust, as well as its relationship with critical team outcomes (Colquitt, LePine, Piccolo, Zapata, & Rich, 2012). Unfortunately, current research has progressed in a disjointed manner that requires the integration of findings before a more parsimonious and descriptive understanding of trust at the team-level can be developed. Beyond this basic understanding, research is needed to explore the nature of trust in teams comprised of diverse members, as multi-national, multi-cultural, and interdisciplinary teams are increasingly characterizing the modern landscape. Thus, this article uses meta-analytic techniques to examine the extent to which mutual trust can serve as an underlying mechanism that drives the diversity-team performance relationship. First, surface-level and deep-level diversity characteristics varied in their impact on trust, ranging from $p = -0.34$ to $0.12$. Value diversity emerged as the most detrimental, along with the moderating effect of time. Second, 95 independent samples comprising 5,721 teams emphasized the importance of trust to team performance with a moderate and positive relationship ($p = 0.32$). Third, mediation analyses answered recent calls (e.g., van Knippenberg & Schippers, 2007) to examine underlying mechanisms that can explain the diversity-outcomes relationship. This showed age, gender, value, and function diversity to be related to performance through mutual trust. Furthermore, this study explores whether contextual (e.g., team distribution) as well as measurement (e.g., referent) issues pose systematic differences in the diversity-trust and trust-performance relationships. Surprisingly, the construct of trust at the team-level proved to be generalizable across a number of unique conditions. In addition to this extensive quantitative review, implications and future research are discussed.

Committee: Eduardo Salas (Chair), Dana Joseph, Barbara Fritzsche, and Shawn Burke

Graduated Summer 2015
Trust Trajectories as a Function of Violation Type and Repair Efforts

AMANDA THAYER
*Psychology PhD - Industrial and Organizational Psychology*

Across domains, organizations and society are facing a trust deficit (Twenge, Campbell, & Carter, 2014). This is problematic, as trust is important to a variety of critical organizational outcomes, such as perceived task performance, team satisfaction, relationship commitment, and stress mitigation (Costa, Roe, & Taillieu, 2001), and has been cited as a motivator for cooperation and knowledge transfer due to its capacity to reduce fear and risk of exploitation (Chen et al., 1998; Fleig-Palmer & Schoorman, 2011; Irwin & Berigan, 2013; Yamagishi & Sato, 1986), and a key component of collaboration. As organizations increasingly rely upon collaboration for achieving important outcomes, it is of critical importance that organizations understand how to not only develop interpersonal trust in collaborative partnerships to facilitate these positive outcomes, but also the way in which interpersonal trust is broken and can be repaired when problems inevitably arise. Though research has begun to investigate trust violation and trust repair, relatively little is known about trust development, violation, and repair as a process that unfolds over time. This is problematic, as cross-sectional studies fail to capture change, both in terms of how trust itself changes as well as how the effect of a violation or the utility of a repair strategy may be weaker or stronger in the long-term than the short-term. Thus, findings from a single point in time may result in different conclusions and recommendations than those that would result from long-term investigation.

Therefore, this study examines how interpersonal trust patterns unfold within individuals, and how these patterns differ between individuals depending on the type of violation and the repair strategy employed. An experimental study using discontinuous growth modeling to examine intraindividual and interindividual differences in trust processes found that generally, trust was negatively impacted more after an intentional (“will do”) violation as compared to a competence (“can do”) violation, such that it had a greater impact on character assessments than a competence violation and also damaged perceptions of ability as much as a competence violation. These negative impacts carried over into trust restoration, which was significantly slower after an intentional violation than a competence
violation. Furthermore, study findings suggest that after an intentional violation, trust restored more quickly when surveillance was implemented than when compensation was offered. Though the opposite did not hold true for a competence violation, the findings did approach significance. Drawing from these findings, implications and future research recommendations are discussed.

Committee: Eduardo Salas (Chair), Dana Joseph, Barbara Fritzsche, and Ramon Rico Munoz

Graduated Summer 2015
Women on the Line: A Qualitative Study of Women’s Experience of Work in the Meat Industry

JESSICA JACQUES
Sociology PhD

This study examines the experiences of women who work in the meat industry. Drawing from symbolic interaction and standpoint theory frameworks, this research focuses on how gender, race, and nationality influence work experiences and family life for women in comparison to men in the meat industry. This study is based on 15 in-depth interviews with men and women who work in management positions and in the processing rooms of meat companies where non-human animals are disassembled in the production of food. Data collection and analysis were performed using grounded theory methods of inquiry. Participants’ stories highlight women’s experience in adapting to the organizational culture of the meat industry, strategies of survival in everyday life in the organization, and the conflict between work and family. While women in management positions discuss the process of fitting into the male-dominated organizational culture, women in the processing room experience gender segregation and inequality that prevents moving into the men’s world of processing management, a separation that is built into the structure of the facility. This study contributes to the literature on work in the meat industry as well as the sociological research on gender and work, race and ethnicity studies and research on the family.

Committee: Elizabeth Grauerholz (Chair), Fernando Rivera, Shannon Carter, and Patricia Martin

Graduated Spring 2015
Undergraduate Prescription Stimulant Misuse: The Impact of Academic Strain, Social Norms, and Gender

LAUREN NORMAN
Sociology PhD

This study investigates the misuse of prescription stimulants among undergraduates for a variety of different purposes, including: academic, other instrumental, and recreational. This research is important as existing literature as well as national level surveillance data indicates a substantial increase in this type of prescription drug misuse, especially among young adults aged 18-25. Drawing from several theoretical frameworks, this research focuses on how academic strain, social norms, and gender influence prescription stimulant misuse among undergraduates. Roughly 900 quantitative surveys were collected that specifically address undergraduate prescription stimulant misuse. The results indicate that college students are at an increased likelihood of misusing prescription stimulants if they experienced academic impediments and/or grade strain during the past academic year. Additionally, the findings show that undergraduates who have accepting attitudes of prescription stimulant misuse and who have peers that misuse prescription stimulants are also at an increased likelihood of misusing prescription stimulants. Furthermore, males were at an increased likelihood of prescription stimulant misuse for academic purposes if they had experienced grade strain during the past academic year in comparison to their female counterparts. Female undergraduates, on the other hand, were four times more likely than male undergraduates to obtain prescription stimulants from their close friends for free.

Committee: Jason Ford (Chair), Amy Reckdenwald, Amanda Anthony, and Roberto Potter

Graduated Summer 2015
Families are conceptualized and accomplished in increasingly diverse ways in the 21st century. A constructionist framework was utilized to examine a widespread contemporary family form, the interspecies family. This mixed-method approach relied on both quantitative survey data and qualitative interview data. First, survey data from the 2006 Constructing the Family Survey were analyzed to understand who in America counts pets as family. Many social demographics were associated and predicted counting pets as family but gender was one of the strongest associations. However, marital status moderated the relationship between gender and counting pets as family at a statistically significant level. Men who are currently or have ever been married are less likely to count pets as family than never married men. Second, I conducted 32 semi-structured, in-depth interviews with 39 people during 2014-2015 in Central Florida to understand how people who count their cats and dogs as family members narrate this process. Narrative strategies documenting exactly how cats and dogs become family members within interspecies family narratives include: time-related narratives, timeless narratives, and patchwork narratives. Additionally, all participants considered their cats and dogs family but only some of them felt like pet-parents. Narratives of childless participants are compared with narratives of parents to examine the impact of family form on the construction of pet parenting narratives. Implications for the family change literature are discussed.

Committee: Elizabeth Grauerholz (Chair), Shannon Carter, Fernando Rivera, and Jessica Greenebaum

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