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Anthropology

Megan Bartrum (#1)
Advisor: Nia Parson
Anthropology, Dedman College

Mothering Angels: Competing Zika Narratives in Brazilian Favelas

The 2016 Zika virus outbreak focused significant international attention on Brazil, aided by proliferating media narratives of poverty-stricken women with visibly microcephalic infants. The perjorative term favelas, densely-packed urban areas, have become central to common understandings of the disease. Lack of decent sanitation, insecure access to basic healthcare, and deteriorating living conditions for urban poor have been produced by inadequate government responsiveness. Ironically, these same concerns capture the attention of public health officials during epidemics as risky sites needing intervention. The specter of the Zika virus and resulting microcephaly has instigated a deployment of over 220,000 Brazilian soldiers and health agents, tasked with distributing educational materials and holding the power to forcibly enter residences. Meanwhile, people experience prevention efforts in light of historically antagonistic interactions with military police. Drawing from 2.5 months in Brazil and media analysis, I explore competing Zika narratives in the epicenter of the outbreak, as well as how these narratives perpetuate health disparities or contest Zika’s meaning. It demonstrates Zika narrative construction vis-à-vis different social actors, strategic mobilization, and its effects on prevention/care access.

Megan Brown (#2)
Advisor: Maryann Cairns
Anthropology, Dedman College

Geopolitical Histories and Environmental Futures: Environmental Education at a Summer Nature Camp for Urban Texas Youth

This project investigates experiential environmental learning and knowledge transmission among urban American children with special attention to emergent themes of environmental values, public responsibility, and geographies of race and power. Participant observation and interviews were used at an urban Texas nature center’s day camp to better understand not only the project of teaching factual and moral environmental information to youth but also the construction of so-called natural spaces and spatial histories of that land. Conducted between June and August 2017, this research included four weeks of on-site observations and interviews with camp staff and children participating in camp. The project also included a qualitative evaluation component in which feedback was provided to camp staff. Camp can expose children to natural spaces positively; camp may also reinforce individual responsibility for environmental stewardship in discussions of pollution, sustainability, and natural resource management.

Afshan Kamrudin (#3)
Advisor: Caroline Brettell
Anthropology, Dedman College

Koe'sister Mentality: Conceptualizing Historical Oppression in Cape Town, South Africa

In South Africa, a koeksister is a fried pastry that is iced and served cold, but among the Muslims in Cape Town, South Africa, the variation of that treat is a Koe'sister; a spiced and fried dough, sugared and topped with coconuts. This variation in pastry is a tell-tale analogy of the system of oppression the Coloured Minority has had not only
suffered from, but generated oppression from as well. This poster will uncover the anatomy and meaning of this emic term used among this group, and will specifically focus on how it is used with regards to queer individuals of the Muslim faith tradition.

Applied Physiology and Wellness

Dustin Allen (#4) Co-authors: Kelly Lenz; Ursa Bezan-Petric; Mu Huang
Advisor: Scott Davis
Applied Physiology and Wellness, Simmons School of Education

Carotid Baroreflex Responses to Simulated Hypotension are Blunted During Passive Whole-body Heat Stress in Young Women

Carotid baroreflex (CBR) function is potentially compromised during heat stress; possibly disrupting the ability to maintain arterial blood pressure in heat. Recently, we demonstrated that CBR function is preserved, if not enhanced, in young men, but remains unknown in women. Therefore, the purpose of this study was to test the hypothesis that CBR-mediated responses are preserved in young women during passive whole-body heating (WBH). Changes in mean arterial pressure (MAP) and HR were assessed in 7 healthy women using 5-s trials of neck pressure (NP, carotid hypotension) and neck suction (NS, carotid hypertension) during normothermia (NT) and WBH (increased core temperature ~1.0 °C). During WBH, CBR increases in MAP and HR in response to NP were blunted (p=0.02 and p=0.02, respectively). CBR-mediated decreases in MAP to NS were similar between thermal conditions (p=0.34), decreases in HR were markedly greater during WBH (p<0.001). Time-to-peak responses for MAP and HR were not altered between thermal conditions for NP or NS (p > 0.05). CBR control of MAP and HR during NP is blunted in females during passive WBH, while control of MAP and HR seems to be preserved, if not enhanced, during NS. This diminished ability to increase MAP and HR in response to hypotensive stimuli during hyperthermia may be a key component in reduced orthostatic tolerance in females during WBH.

Lance Brooks (#5)
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Ground Force Application during a Sprint Start: Optimal Not Maximal?

The ability to accelerate is a desirable attribute for competitive sprinters and can be affected largely by the amount of force produced through the initial push out of the blocks, or step-zero. We wished to explore the limits of force production by the musculoskeletal system at a forward-oriented ground-reaction-force angle (GRF-A), like ones seen in sprint situations, when not limited by friction, balance, and trajectory. The present hypothesis is that subjects will produce force sub-maximally during normal sprint conditions in order to account for these factors. We collected horizontal and vertical ground-reaction-force (GRF) data from three recreationally trained adult male volunteers. Each subject performed two trials of both a Normal Track Start (NS) and a Mat Dive (MD). Resultant GRF-A and magnitudes (GRF-V), normalized to bodyweight (BW), were determined for each trial and averaged for both tests. Average GRF-A for the NS and MD trials were 56.6 and 54.7 degrees, respectively. Average GRF-V for the NS and MD trials were 1.31 and 1.42 BW, respectively. We concluded that since the subjects were able to increase their total force production in the absence of the aforementioned limiters, a decrease in force production to less than maximal values is necessary in order to perform a successful sprint event.
Dynamic Cerebral Autoregulation Impairment Persists Past Resolution of Symptoms in Collegiate Athletes Following Concussion

The purpose of the study was to examine dynamic cerebral autoregulation (dCA) in collegiate athletes day 3, 21, and 90 following a concussion and compare them with non-injured controls. 27 athletes with a sports-related concussion were enrolled. Data was collected on days 3, 21, and 90 post injury. 25 controls were also enrolled at one time point. Symptoms were measured using the SCAT-3. Depression scores were assessed with PHQ-9. Continuous mean arterial blood pressure (MBP) and middle cerebral artery blood flow velocity (MCAV) was obtained at rest and during a squatting exercise. dCA was estimated from transfer function (Tf) analysis of beat to beat fluctuations in MBP and MCAV within the low (LF) and high frequency ranges. Effective dCA corresponds to a low Tf gain.

Compared to controls, concussed athletes exhibited higher symptoms (12±6.8vs2.4±3.4;p<.001) and PHQ-9 score (8.7±5.6vs2.1±2.1;p<.001) on day 3. No difference was observed with symptoms or PHQ-9 on day 21 compared to controls. LF Tf gain at rest was higher day 3 (1.3±.34vs1.0±.28U;p=.02) and 21 (1.3±.45U;p=.03) compared to controls. LF Tf gain during exercise was higher on day 3 (1.5±.34vs1.1±.29 U;p<.001) and 21 (1.5±.22U;p<.001) compared to controls. No differences were observed between day 90 and controls. dCA is impaired at rest and during exercise up to 21 days post-concussion despite improvement in symptoms.

Persistent Impairment in Cerebral Vasoreactivity in Subacute Phase Following Concussion

Concussion diagnosis is characterized by a lack of objective markers, as there is a paucity of better understanding of the pathophysiology. Cerebral vasoreactivity (CVR) utilizing transcranial Doppler ultrasonography (TCD) may be a useful, objective biomarker for physiological recovery. PURPOSE: To determine the link between symptoms and CVR on Day-3, Day-21 and Day-90 following a concussion. METHODS: Data was obtained on Day-3, Day-21 and Day-90 (N=17) from concussed collegiate athletes (N=27) and compared to age and sports-matched non-injured controls. Using TCD, continuous middle cerebral artery blood flow velocity (MCAV) was evaluated in response to changes in End-tidal CO2 during normal breathing (normocapnia), inspiring a gas mixture of 8% CO2, 21% oxygen (hypercapnia) and hyperventilating (hypocapnia). RESULTS: On Day-3, concussed athletes showed higher symptom number (2.5±3vs.12.1±7;P<.0001) and severity (4.2±6vs.29.5±23;P<0.0001), higher depression score (2.2±2vs.9.1±6;P=0.0003) and lower cognitive score (28.1±2vs.26.4±2;P=0.0025). Compared to controls (2.3±0.3), the concussed group showed reduced CVR on Day-3 (1.8±0.4;P=0.0001), Day-21 (2.0±0.4;P=0.0017) and Day-90 (1.9±0.6;P=0.023). CONCLUSION: Despite resolution of symptoms and cognitive score by Day-21, CVR continued to be blunted by Day-90 suggesting persistent physiological impairment beyond symptom resolution.
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Ground Reaction Forces During Competitive Track Events: A Motion Based Assessment Method

A motion based approach to generating vertical ground reaction forces (VGRF) from the motion of sprint running could be a useful analytical tool. The spring-mass model has been used for this purpose; however, the invariant pattern predicted by the model is not fully consistent with the force-time waveforms of competitive sprint athletes. The recently introduced two-mass model provides an alternative method that might generate better representations of sprinter’s force-time waveforms. Here we used both models to generate kinematic-averaged force-time waveforms from four sprint athletes in an IAAF 100-meter race from 360 Hz video data. We found substantial differences in the waveform patterns predicted by the two models. The two-mass model predicted-waveforms had greater peak forces (4.75 times body weight) that occurred earlier in the contact interval (28 milliseconds) vs that of the spring mass model. Usain Bolt was one of the four sprint athletes evaluated in this study. The results of our model’s evaluation of his running mechanics from video suggest that the right and left legs of the world’s fastest man may perform differently, defying current scientific assumptions about running gaits and performance.

Commercial Viability: Ground reaction force curves during running, walking and other activities (i.e. jumping, hopping, etc) can be analyzed to obtain a variety of important variables. These include: impact forces, loading rates, maximum forces, applied impulses, and foot-ground contact times. These parameters are important evaluation tools for footwear analysts, physical therapists, coaches, orthopedic surgeons, podiatrists, and trainers. Accordingly, our experimental demonstration of model efficacy for improved prediction of peak forces, limb loading rates and tissue stresses in comparison to current methods identifies applications for smart shoe sensing capabilities, orthotics, prosthetics, and exoskeleton design. Implementation in a shoe store, athletics performance facility or clinical site would involve a treadmill or runway and the instrumentation needed to acquire the limited motion data needed from the subject. The subject would run at the selected speed while his or her motion data is captured and used in conjunction with software that incorporates the model’s algorithms in order to generate ground reaction force waveforms. The waveforms would be used to analyze and potentially customize the needs of the subject for footwear, orthotics, and/or gait retraining to improve performance and/or minimize injury risk, etc.

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Cardiac Vagal Tone Impairment is Associated with Reduced Cerebral Blood Flow in Collegiate Athletes Following Concussion

Since cardiac vagal tone (CVT) is associated with disturbances in the ANS, deficits in cerebral blood flow (CBF) may be linked to CVT impairment post-concussion. The study examined CVT and CBF in athletes on days 3 (N=29), 21 (N=25) and 90 (N=17) post concussion compared to controls (N=29). CVT was assessed via 3-lead ECG (HF; 0.15-0.4 Hz), mean arterial pressure (MAP) via finger photoplethysmography and middle cerebral blood flow velocity (MCAV) via Transcranial Doppler ultrasonography (TCD). For vascular tone, cerebrovascular conductance index (CVCi) was estimated (MAP divided by MCAV). The SCAT-3 and Trails test A & B were also used. On day-3, concussed athletes had low cognition (SAC 28±1vs.26±2, P=0.0005; Trails B 48±8 vs. 58±15sec, P=0.006) and HF power (52±12 vs. 36±14, P=0.006). On days 21 and 90, values were comparable to controls. When day-3 subjects were categorized based on MCAV (divided at median), the low MCAV group had lower HF power (29±13 vs. 42±11, P=0.006) and CVCi (0.60±0.13 vs. 0.88±0.13, P<0.0001) than the high MCAV group. Low
MCAV group also had poor cognition (Trails A 21±5 vs. 16±3 P=0.03; Trails B 52±9 vs. 39±7 P=0.002; Adjusted Trails B 31±10 vs. 23±6 P=0.03; SAC 26±2 vs. 28±2, P=0.04) on day 21. CVT was impaired 3 days post concussion compared to controls. Lower CBF was associated with higher cerebrovascular tone, blunted CVT, and reduced functional outcome on day 21.

Amanda Woodruff\textsuperscript{10} (#10)
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Physiological Complexity of Postural Control Is Impaired Despite Resolution of Postural Sway Following Sport-Related Concussion

When healthy, high complexity and entropy are associated with physiological functions of postural control and low levels with pathologies. This study examined postural control dynamics utilizing postural sway and complexity on days 3, 21, and 90 post-concussion compared to matched control athletes. Force plate measurements were taken during quiet standing for 60-sec trials with eyes open (EO) and close (EC). Sway was estimated from the deviations of center of pressure (COP) in anteroposterior direction. Multiscale entropy analysis determined postural complexity index – sum of entropies computed for different time resolution scales of the COP signal. Independent t-tests compared data between groups. Concussed athletes had greater sway (EO 27.2±9.1mm vs 22.0±5.3mm P=0.0190; EC 30.7±10.7mm vs 22.4±5.1mm P=0.0014) and lower complexity (EO 2.8±0.9U vs 3.8±0.9U P=0.0008; EC 3.1±0.9U vs 4.0±0.8U P=0.0009) 3 days post-concussion than controls. Sway was high in EC trial (27.7±9.6mm P=0.0255) and complexity was low in EC and EO trials (EO: 3.2±1.0U P=0.0468; EC: 3.4±0.9U P=0.0256) 21 days post-injury. Despite no difference in sway between groups, complexity stayed low 90 days post-concussion (EC 3.5±0.8U P=0.0497). Postural complexity may be a sensitive biomarker for examining postural control dynamics and play a role in return-to-play decisions and prevention of related injuries.

Biology

Hind Alkhaldi (#11)
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Assembly of the Peripheral Arm Subunits of Bacterial Complex I

Complex I (NADH: ubiquinone oxidoreductase) is the largest enzyme of the mammalian mitochondrial respiratory chain. During the oxidation of NADH, hydrogen ions are translocated across the mitochondrial membrane, leading to the synthesis of ATP, the chemical energy currency of cells. Complex I in E. coli contains 13 different subunits, encoded by the nuo operon, that form an L-shaped complex: a peripheral arm, containing 6 subunits involved in electron transport, and a membrane arm containing 7 subunits involved in pumping hydrogen ions. Mutations in Complex I genes in humans lead to vision loss, brain dysfunction, or loss of muscle function, and such disorders are commonly due to the poor assembly of Complex I. One issue we will address is the order in which the 13 subunits (nuoA-N) come together to form a functional complex. Peripheral arm subunits can be separated into two groups E, F, and G, which form an NADH binding domain, and B, CD, and I, which form the interface with membrane subunits A and H. We will test groups of subunits to see if they can assemble to form subcomplexes, as indicated by native gel analysis. Preliminary results show that an EFG complex can form when all genes nuoA-I are expressed.
together. We will also study mutations that are associated with disease in humans, and model them in our bacterial system.

Lauren Ammerman (#12) Co-authors: Amila Nanayakkara; Maha Aljowni; Alexander R. Lippert; Pia D. Vogel; John G. Wise
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Novel Inhibitors of P-Glycoprotein from In Silico Optimizations of Inhibitor SMU-29 Using the ChemGen Program

P-glycoprotein (P-gp) is a membrane efflux pump that can lower the intracellular concentration of many drugs to sub-therapeutic levels. Consequently, P-gp is implicated in multidrug resistance (MDR) to cancer chemotherapies. One P-gp inhibitor, SMU-29, was identified by us using in silico methods and later confirmed to reverse MDR in cancer cells. To optimize SMU-29, we created millions of chemical SMU-29 variants using our novel program, ChemGen. In one set of variants, one part of SMU-29 was varied; in a second set, only SMU-29’s central structural scaffold was conserved. In silico docking identified SMU-29 variants with high estimated affinities for P-gp’s nucleotide binding domains (NBDs), and low estimated affinity for P-gp’s drug-binding domain (DBD). We identified over 2000 ChemGen variants with better estimated affinities at the P-gp NBDs relative to SMU-29. We selected a small set of variants for synthesis and screening against MDR cancer cell lines. All of the tested SMU-29 variants acted as P-gp inhibitors with improved PC50 values. Some of the variants also inhibited Breast Cancer Resistance Protein (BCRP), which is also implicated in cancer MDR. Our initial screens had a 33% P-gp inhibitor identification success rate; the present in silico optimization of SMU-29 has demonstrated a very high success rate of identifying P-gp inhibitors with improved affinities.

Commercial Viability: Our novel medicinal chemistry program, ChemGen, can be used to create chemically-correct variants in silico of nearly any molecular structure. This program has significant potential for aiding researchers in generating large libraries of chemical variants to pharmacologically optimize any molecule at a very low cost.

Mike (Gang) Chen (#13) Co-authors: Jett Ballou-Crawford; John Wise; Pia Vogel
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Mechanistic Studies of Drug-Like Inhibitors of P-glycoprotein using ATPase Assays, Electron Spin Resonance Spectroscopy and Cancer Cell Models

Multidrug resistance (MDR) in cancer and other diseases is frequently associated with transmembrane efflux proteins, one of which is P-glycoprotein (P-gp). Over-expression of P-gp in cancer cells increases the efflux of therapeutic drugs rendering them ineffective. In order to re-sensitize multidrug resistant cancers to chemotherapy, we have found inhibitors of P-gp by in silico screening methods (Brewer et al., Molecular pharmacology 86, 716-726, 2014), and several of these inhibitors were shown to successfully overcome MDR in the drug resistant DU145TXR prostate cancer cell line (Follit et al., Pharmacol. Res. Perspect. 3, e00170, 2015). In this study, we expanded our cell culture screening to evaluate 25 new compounds identified by our in silico screening method and report that over 30% of these compounds re-sensitized DU145TXR cancer cells to chemotherapy, while not exhibiting significant toxicity to the non-cancerous human lung fibroblast (HFL-1) cell line. The best of the identified hit compounds were further investigated with regard to the mechanism of inhibition using ATPase activity assays and electron spin resonance...
spectroscopy (ESR). Several of the best compounds were found to inhibit ATPase activity. Using a spin-labeled ATP analog and ESR spectroscopy, we assessed the effects of the identified inhibitors on ATP binding to P-gp.

Maissa Correa de Oliveira (#14) Co-authors: Collette Lavigne; Brandon Tran; Michael Fowler; Dakota Okwuone; Roxana Farokhnia; John Wise; Pia Vogel
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Optimization of Breast Cancer Resistance Protein (BCRP) Expression in the Yeast Pichia pastoris

Multidrug resistance (MDR) has been linked to the failure of chemotherapy and reduced survival rates in patients in several cancer types. MDR cancers often become resistant to pharmacologically and structurally diverse drugs by overexpressing members of the family of ABC transporters. The breast cancer resistance protein (BCRP) is expressed in many tissues and is responsible for the active export of a wide variety of toxins across the plasma membrane. To search for BCRP inhibitors as potential leads for the development of co-therapeutics to combat MDR, we used high-throughput in silico ligand docking and a number of drug like molecules identified could reverse multidrug resistance of a BCRP-overexpressing breast cancer cell line generated in our lab. To understand the mechanism of inhibition of BCRP by these compounds, biochemical assays assessing ATP hydrolysis activity as well as other biochemical properties of BCRP are required. A gene for human BCRP was designed with optimized codon usage for translation and expression in P. pastoris and cloned into two strains: GS115 and PichiaPinkTM. BCRP expression was confirmed in both strains and the ATP hydrolysis assays on membranes suggested that the protein expressed was catalytically active. Here we also report our attempts to purify BCRP from GS115 and PichiaPinkTM membranes and characterize the protein in mixed micelles.

Elnaz Ghotbi Ravandi (#15)
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The Recognition of Target Gene Transcriptional State by Polycomb Group Proteins

Polycomb Group proteins are epigenetic transcriptional regulators that maintain the transcriptional repression of silenced genes. Most studies on PcG proteins have been focused on the maintenance phase of PcG silencing, thus the molecular mechanisms by which PcG proteins initially recognize a repressed gene remain unknown. Our lab previously used embryos from bcd osk tsl females, in which giant (gt), a PcG-target gene, is uniformly repressed by PcG proteins. ChIP experiments on bcd osk tsl embryos in different embryonic stages showed the weak presence of PcG proteins at gt in earlier stages prior to their stable binding in later embryonic stages. On the other hand, we generated a genetic system in which gt is ubiquitously expressed by producing embryos that lack the gt repressor, Hb. Time course ChIP experiments on the resulting embryos demonstrated greatly reduced binding of PcG proteins at the ubiquitously expressed gt gene compared to the PcG-mediated repressed gt gene from bcd osk tsl females. In order to determine whether binding by particular transcription factors or the transcriptional state of a target gene identifies PcG target loci as initially repressed, we will examine whether PcG silencing complexes assemble at a transcriptionally inert gt transgene in a background in which endogenous gt is transcriptionally active. Progress on these studies will be presented.
Determining Expression of Multidrug Transporters in Human Cells Using PCR

ATP-binding cassette (ABC) transporters are transmembrane proteins that act as drug efflux pumps and are associated with multi-drug resistance (MDR) in cancers. Two specific proteins that belong to this protein superfamily are P-glycoprotein (P-gp) and breast cancer resistant protein (BCRP). These proteins are known to pump chemotherapeutics out of cells, rendering treatments of some cancers less efficient. Certain cancer cell lines overexpress these proteins, leading to MDR. The levels of expression of P-gp and BCRP were quantitatively measured in four cancer cell lines that are used by us to screen for inhibitors of P-gp or BCRP. The expression of P-gp, BCRP, and MRP1 (multidrug resistance-associated protein 1) was measured using quantitative One-Step qPCR in a prostate cancer cell line, DU145, and compared to an MDR derivative line that overexpresses P-gp, DU145 TXR. We found that DU145 TXR expresses P-gp, BCRP, and MRP1 by about 14,000-fold, 4-fold, and 0.75-fold, respectively, when compared to the parental cell line, DU145. A breast cancer cell line, MCF-7, and its mitoxantrone-resistant derivative, MCF-7 M100, were also analyzed. The MCF-7 M100 cell line was found to express BCRP, P-gp, and MRP1 by about 600-fold, 0.3-fold, and 1.6-fold, respectively, compared to the parental cell line, MCF-7.

The HTLV-1 Latency-Maintenance Factor p30ll Drives T-cell Lymphoproliferation and Mitochondrial Antioxidant Signaling During Retroviral Carcinogenesis

The human T-lymphotropic virus type-1 (HTLV-1) is a hematotropic oncoretrovirus that transforms and promotes the aberrant proliferation of infected CD4+ T-cells. Approximately 3-5% of HTLV-1 cases will develop adult T-cell leukemia/lymphoma (ATL). Most ATL patient isolates contain a highly-conserved nucleotide sequence, known as pX, which encodes several non-structural/regulatory proteins, including Tax, p8I, p12I, p13ll, p30ll, Hbz, and Rex. The HTLV-1 p30ll protein is a latency-maintenance factor that deregulates host signaling pathways associated with cell cycle progression and cell survival. Our lab has previously shown that p30ll cooperates with the oncoprotein c-MYC. The overexpression of oncogenes, such as c-MYC, can induce the accumulation of reactive oxygen species (ROS) causing DNA-damage and apoptosis. Our lab recently demonstrated that the HTLV-1 p30ll protein induces the Tp53-induced glycolysis and apoptosis regulator (TIGAR). TIGAR scavenges c-Myc-induced ROS, and inhibits oncogene-induced cellular senescence. TIGAR is highly expressed in HTLV-1-infected lymphoma T-cell lines and ATL clinical samples. The roles of mitochondrial antioxidant-signaling in promoting oncogene-activation during viral carcinogenesis are not well understood. These studies allude to a pivotal role for the p30ll latency-maintenance factor in promoting oncogene-activation through the induct
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Understanding Spinocerebellar Ataxia-3 / Joseph-Machado Disease

Machado–Joseph disease (MJD, also known as spinocerebellar ataxia type 3, SCA3), is the most common inherited spinocerebellar ataxia. The disease is caused by an abnormally long polyglutamine (polyQ) repeat in the ataxin-3 protein and characterized by progressive ataxia, affecting balance, gait and speech resulting from neuronal loss in the cerebellum, thalamus, midbrain, and spinal cord. The length of the expanded polyQ stretch correlates positively with the severity of the disease. Although several activities have been described for ATX3, including the regulation of transcription, a major function is as a deubiquitinating enzyme. Exactly how mutant ATX3 causes neurodegeneration is not known. To examine this issue I established a cell culture model of SCA3 using cultured cerebellar granule neurons. I found that while normal ATX3 localizes primarily to the soma and axons, mutant ATX3 localizes to the dendrites. Also, I found that ATX3 interacts with histone deacetylase-3 (HDAC3), a protein with well-established neurotoxic effects and that is localized both in the nucleus and cytoplasm. In collaboration with Dr. Doris Kretzschmar’s lab, we found that FoxP1 is also protective in a Drosophila model of SCA3. Our results suggest that approaches to inhibit HDAC3 activity and/or increase FoxP1 expression could represent an attractive treatment strategy for SCA3.

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HTLV-1 p30II Inhibits Tax- Induced NF-kappa B-Signaling in the Lipid Rafts, Genomic Instability, and Cytotoxicity

The human T-cell leukemia virus type-1 (HTLV-1) infects CD4+ T-cells and causes adult T-cell leukemia/lymphoma (ATLL), an aggressive and often-fatal lymphoproliferative disease. The viral transactivator Tax functions as a pleiotropic regulator of cellular signaling pathways, including NF-kB. Tax recruits and activates IKK signalosome to membrane lipid rafts and constitutively activates NFkB pathway. The activation of NF-kB by Tax is mediated through binding of Tax to the regulatory subunit of the IkB kinase (IkK), NEMO or IkKg. This interaction results in constitutive activation of IkKa and IkKB, degradation of IkBalpha, and activation of both canonical and non-canonical NF-kB pathways. Tax also inhibits p53 functions through NF-kB-signaling. Moreover, previous studies from our lab have shown the HTLV-1 latency-maintenance factor p30II cooperates with cellular oncoproteins and induces aberrant lymphoproliferation through the activation of p53-dependent pro-survival genes. The stathmin gene is negatively regulated by p53/mSin3a/HDAC1 repressor complexes and has been shown to play an oncogenic role in a range of invasive cancers. Stathmin is a microtubule-destabilizing factor and was recently shown to interact with p65-RelA complexes associated with aggressive disease phenotypes in pancreatic cancers. We therefore hypothesize p30II might suppress NF-kB-mediated cytotoxicity.

Commercial Viability: These findings suggest that p30II cooperates with the viral transactivator protein and may promote the survival of HTLV-1-infected leukemic T-cells by dampening Tax-induced NF-κB-signaling and inhibiting Tax-induced genomic instability. It is conceivable that anticancer chemotherapy compounds which activate p53 or inhibit NF-κB-mediated inflammation could have the unintended consequence of promoting the survival of ATLL tumor cells by suppressing Stathmin levels and inhibiting Tax-induced cytotoxicity.
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In Silico Identified Inhibitors of ABC Transporters Increase Chemotherapy Efficacy in Multidrug Resistant Cancer Cell Culture Models

Lack of clinically approved P-glycoprotein (P-gp) and breast cancer resistance protein (BCRP) inhibitors renders chemotherapy treatments of many multi drug resistant cancers ineffective and obstructs drug delivery into the brain through blood brain barrier. Here, we show that co-administration of the computationally identified P-gp inhibitors, SMU-29, 34 and 45 with paclitaxel led to increased apoptosis in a P-gp overexpressing cancer cell line (DU145TXR). Treatment of DU145TXR cells with the known P-gp inhibitor, tariquidar, led to significant intracellular accumulation of the P-gp substrate, daunorubicin, while the presence or absence of tariquidar had no influence on accumulation of SMU-29, 34 and 45, indicating that the novel inhibitors are not P-gp transport substrates. Studies indicated that 34 and 45 did not affect BCRP transport activities, while compound 29 affected both P-gp and BCRP catalyzed transport. Additional experiments indicated that chemical variants of SMU-29 exhibited higher efficacy in cell viability assays and led to increased accumulation of P-gp substrates compared to the parental compound. We have identified several compounds that potentiated the accumulation of the BCRP substrate, Hoechst 33342, in BCRP overexpressing MCF-7 M100 cells suggesting that these compounds inhibited BCRP.

Piao Ye (#21)
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Biology, Dedman College

The Contributions of Multiple Factors in PcG Recruitment

Polycomb-group(PcG) proteins are conserved epigenetic transcriptional regulators that are capable of maintaining transcriptional repression through an indefinite number of cell cycles. giant(gt) is a gap gene in Drosophila and also a PcG target gene. Hunchback(Hb) is a repressor for gt. Previously we found that PcG takes over gt repression after Hb is degraded. We have generated a genetic system in which maternal hunchback Hb is expressed ubiquitously but zygotic Hb expression is absent. Chromatin immunoprecipitation (ChIP) analysis of embryos at multiple developmental stages has been performed to determine the timing and locations of binding by transcription factors, PcG proteins, and deposition of histone modifications. In order to determine the roles played by individual proteins or protein complexes in establishment of PcG silencing, individual proteins will be knocked down using combinations of a maternal Gal4 driver and UAS- shRNA-expressing transgenes. Current work includes generating fly cage for embryo collections following ChIP experiments. Results from these ChIP experiments will show whether PcG proteins has changed missing certain protein.

Fang Zhang (#22)
Advisor: Steven Vik
Biology, Dedman College

Exploring Assembly Pathway and Clinical Mutations of Membrane Subunits LMN of Complex I

NADH:ubiquinone oxidoreductase, also known as Complex I, is the first and largest enzyme of the respiratory chain and has a central role in cellular energy production. The 3-dimensional structure of Complex I has now been
determined, but the assembly pathway of the of 13 subunits of Complex I is uncertain. This study will analyze the assembly pathway of membrane subunits LMN in Complex I. We use E. coli enzyme as a model system to identify the key interactions of membrane subunits during the assembly pathway. Assembly is tested by expressing these genes, and using a gentle detergent, dodecyl maltoside, to extract complexes from cellular membranes. In addition, we analyze clinically-identified mutation L158P (Mitchell, 2006; Alvarez-Iglesias, 2008) which is located at the interface of membrane subunits M and N, to better understand aberrant assembly. Our results so far have indicated that expression of all subunits leads to a large complex that appears to be Complex I. Expression of LMN subunits leads to formation sub-complex MN during the assembly pathway, but subunit L is absent. L seems to form a homodimer.

Yiyu Zhang (#23) Co-authors: Jade Franklin
Advisor: Santosh D'Mello
Biology, Dedman College

Neuroprotection by NF-kB Subunit RelA/P65 in Cell Culture Models of Huntington’s Disease and Spinocerebellar Ataxia Type-1

We and other labs previously described that RelA/p65, a subunit of the NF-kB transcription factor, protects cultured neurons against death induced by a variety of apoptosis-inducing stimuli. We have now extended these studies to cell culture models of neurodegenerative diseases. We previously described that expression of endogenous p65 is not altered in various paradigms of neuronal apoptosis. We find that expression was not discernibly altered in the striatum of R6/2 mice, a commonly used mouse model of HD. Mutation of five different acetylation sites either individually or in combination had no effect on mut-Htt-mediated neuroprotection. Similarly, mutation of two separate phosphorylation sites, Ser 467 and Ser 534, had no effect. Co-immunoprecipitation analyses showed that p65 interacted with huntingtin (Htt), but not with SCA-1, a finding that was confirmed through co-localization studies. While interacting between p65 and wild-type Htt was strong, it was lower with mutant-Htt. Further analysis using deletion constructs localized interaction of p65 to the 1 – 75 amino acid region of Htt. Current research is aimed at understanding in more detail the mechanism by which p65 protects against neurotoxicity by mutant-Htt and mutant-SCA1.
Chemistry

Maha Aljowni (#24)
Advisor: Alexander Lippert
Chemistry, Dedman College

Synthesis of Anti-Cancer Drugs to Inhibit P-gp Pumping Action

A problem with cancer treatment is that many cancers develop resistance to chemotherapeutic agents, causing them to fail to accumulate in resistant cancer cells long enough to have any effect. This is due to the overexpression of a plasma membrane protein called P-glycoprotein (P-gp). Generally, the role of P-gp is to protect the cells from any toxins or foreign substances by pumping these toxins (including chemotherapeutic drugs) out of the cell. I am collaborating with the Wise-Vogel laboratory at Southern Methodist University, who utilize a computer-generated model to predict the structures of P-gp inhibitors that inhibit the action of P-gp. These docking models find drug targets that slow the action of P-gp pumping, as well as help understand the underlying mechanism of how the protein effluxes toxins from the cell. My current research is focused on multiple drug analogues that are predicted to inhibit the P-gp protein based on their docking models. These are tested in cancer cell lines in combination with current chemotherapeutics to determine efficacy and strength of inhibition so that future chemotherapeutic drugs can work effectively in cells.

Weiwei An (#25) Co-authors: Jian Cao
Advisor: Alexander Lippert
Chemistry, Dedman College

Development of a Chemiluminescence Probe for Nitroxyl

Nitroxyl (HNO) is a reactive nitrogen species related to nitric oxide that shows distinct therapeutic potential, including the possibility as a treatment method for heart failure. The one-electron reducing capacity can be seen in the reactions with metals or metalloproteins. The low H-NO bond strength implies that HNO could go through series redox reactions in biology systems. However, a clear understanding of endogenous HNO generation in mammalian systems remains sparse because of a lack of efficient HNO probes. To further understand the in vivo mechanism and endogenous pathways of nitroxyl, a chemiluminescent nitroxyl probe based on the spiroadamatane 1,2-dioxetane has been synthesized and characterized. This talk will discuss the development and applications of this probe.

Nassim Beiranvand (#26)
Advisor: Elfi Kraka
Chemistry, Dedman College

Conformational Study of Deoxyribonucleotides; Novel Tools to Understand Hydrogen Bond and Ring Puckering

Deoxyribonucleotides are monomeric units to build up DNA that has many functions in living organisms. Deoxyribonucleotide consists of three major components: sugar ring, a phosphate group and nitrogenous base. The four deoxyribonucleotides differ according to the base attached to the deoxyribose sugar. (1-deoxycytidine, 2-deoxythymidine, 3-deoxyadenosine, 4-deoxyguanosine). We have analyzed so far the conformational energy and geometrical parameters of the deoxyribonucleotides (1and 2) along the conformational path traced out by the 5-
memberd sugar ring to understand the correlation between ring puckering and internal hydrogen bonding, which determines the biological function. To fulfill these tasks, we have used a combination of the Cremer-Pople Ring Puckering Analysis and the Local Mode Analysis of Konkoli and Cremer, which describe the conformational process at the quantum mechanic level. The results show that the global minimum for deoxyribonucleotides (1 and 2) is found for the twist form of the sugar ring. The planar form is less stable by $\Delta E=5$ (kcal/mol). Based on the calculated local stretching force constants of the type CH…O, the number of H-bonds and their strength change during puckering process. The minimum number of hydrogen bonds are found for the envelope form.

![Planar Sugar Ring](PlanarSugarRing.png)  ![100% Twist form](100PercentTwistForm.png)  ![70% Twist form](70PercentTwistForm.png)

Caleb Bunton (#27) Co-authors: Zahra Bassampour
Advisor: David Son
Chemistry, Dedman College

**Polysiloxane-Based Materials for Drug Delivery**

Drug delivery devices have recently received a lot of attention with many diverse types of devices becoming available as powerful tools for researchers and medical practitioners. Material design plays a significant role in the quality and improvement of these devices. In this study, polysiloxanes have been utilized to produce a crosslinked material via hydrosilylation for drug delivery applications. These crosslinked materials are highly efficacious in terms of dosage control and bio-compatibility. Drug release rate increases with decreasing crosslink density and conversely, decreases with increasing crosslink density. Furthermore, release direction (vector) can be controlled through mechanical means.

**Commercial Viability:** Many types of materials are currently available for use towards drug delivery components and devices. Most of these materials however, do not allow for controlled drug release but rather a singular release rate as specified by the material used. Furthermore, some of these materials may not be suited for use on or in certain areas of the body due to tissue incompatibility (adverse reaction). The design of our materials effectively fixes these problems with conventional drug delivery materials, allowing for a singular material that is capable of controlling drug release rate through crosslink density, as well as affording a high level of biocompatibility in all tissues.
Jian Cao (#28) Co-authors: Weiwei An; Audrey Reeves  
Advisor: Alexander Lippert  
Chemistry, Dedman College

A Chemiluminescent Probe for Cellular Peroxynitrite Using a Self-Immolate Oxidative Decarbonylation Reaction

Peroxynitrite (ONOO−) is a highly reactive oxygen species and has recently been recognized as an endogenous mediator of physiological activities such as immune functions. While its biological importance is becoming clearer, many of the details of its production and functions in living systems remain elusive due to a lack of available selective and sensitive detection methods. Herein, we report the first reaction-based chemiluminescent probe (PNCL) for ONOO− based on a previous reported selective reaction by our lab, ONOO− initiated oxidative decarbonylation of isatin to generate anthranilic acid. PNCL was made by appending the isatin functionality into Shabat’s acrylonitrile incorporated spiroadamantane 1,2-dioxetane. PNCL-1 detects ONOO− with high sensitivity and selectivity. Furthermore, PNCL has been applied for ONOO− detection in aqueous solution and live cells. Moreover, PNCL can be employed to detect cellular ONOO− generated in macrophages stimulated to mount an immune response with lipopolysaccharide (LPS). The unique advantages of chemiluminescent detection coupled with the specificity of the oxidative decarbonylation reaction provides a useful tool to explore ONOO− chemistry and biology.

Alan Humason (#29)  
Advisor: Elfi Kraka  
Chemistry, Dedman College

Is There a Limit to the Longest C-C Bond in Chemistry? A Study by Vibrational Spectroscopy

The Local Mode Analysis of Konkoli, Cremer and Kraka is used to investigate the full range of covalent C-C bonds in organic chemistry, giving a unique description of bond strength. This method is found to be accurate and more a generally applicable bond strength metric than the conventional parameters of bond length or bond dissociation enthalpy. The factors that lengthen and shorten a C-C bond are investigated in this work. It is found increasing bond order and carbon hybridization will shorten bonds, as expected. Among the factors that lengthen a bond, steric strain from the addition of bulky groups has the least effect, bond clamping and diamondoid restricted structures have similar strong effects, and electron deficiency has the strongest effect, resulting in the longest C-C bonds in chemistry. Combining electron deficiency with clamped or diamondoid structures are investigated, to determine how a longer covalent bonds can be formed. The final analysis determines the longest possible C-C bond in chemistry.

[NiFe] hydrogenases are enzymes that contain an unusual bimetallic cluster centre being composed of nickel and iron. These enzymes provide energy to an organism and balance a redox potential of its cells by activating hydrogen. Several studies have shown that hydrogenases are able to serve as clean energy carriers or potential transportation fuel. In this work, we present two models of the [NiFe] hydrogenase active site, each containing two phosphine ligands and a ligand L in a trans position, which is modified in order to weaken the Fe-H bond, a prerequisite for hydrogen release. In both models, the -NO2 and -CH3 ligands weaken the Fe-H bond, while the H2S, NH3, H2O ligands make the Fe-H bond the strongest. We observe in our calculations that those ligands, which make the Fe-H bond weaker such as -CH3 or -NO2, make the H-H bond stronger. Conversely, those ligands which make the Fe-H bond stronger in both models (like NH3 or H2O), make the H-H bond weaker.

Model 1

Model 2

L = PH3, H2O, NH3, H2S, -Cl, -SCN, -NCS, -F, CO, -OH, -CN, NO, -NO2, -CH3, -C2H5, -C6H5, C2H4
Sadisha Nanayakkara (#31) Co-authors: Velmurugan Gunasekaran
Advisor: Elfi Kraka
Chemistry, Dedman College


The Unified Reaction Valley Approach (URVA) focuses on the close relation between reaction complex and its reaction path on the potential energy surface during a chemical reaction. The curving of the reaction path reflects all electronic changes taking place, e.g. curvature peaks are the locations where bonds are broken or formed. In the Quantum Theory of Atom-in-Molecule (QTAIM) Analysis, changes in the topological properties of electron density $\rho(r)$ are used to monitor bond forming/breaking events. Two atoms forming a chemical bond are connected by a bond path, which disappears if the bond is broken. In the present work, we systematically compared these two approaches for a series of chemical reactions including the hydrogen migration in HN2+, the CH3 + H2 reaction as well as the Gold(I) catalyzed [3,3]-sigmatropic rearrangement of allyl acetate. In the close vicinity of a curvature peak indicating a significant change in the reaction complex, we could observe notable changes in the $\rho(r)$ bond path too.

Khashayar Rajabimoghadam (#32) Co-authors: Isaac Garcia-Bosch
Advisor: Isaac Garcia-Bosch
Chemistry, Dedman College

Catalytic Aerobic Oxidation of Alcohols by Copper Complexes Bearing Redox-Active Ligands with Tunable Hbonding Groups

In this poster, we describe the structure, spectroscopy and reactivity of 1st row metal complexes bearing bidentate redox-active ligands that contain H-bonding donor groups. These unsaturated tetracoordinate complexes are stabilized by intramolecular H-bonding interactions between the two ligand scaffolds and between the ligand H-donor and the metal center.3 Interestingly, the copper complexes were found to be able to undergo multiple oxidation-reduction processes associated with the metal ion (CuI to CuIII) and the o-phenyldiamido ligand (diamido, diiminato radical and diimine). Some of the copper(II) complexes could carry out the oxidation of alcohols to aldehydes or ketone using only O2 and at room temperature. Like in galactose oxidase, the copper(II) complexes are proposed to deprotonate and coordinate the alcohol substrate and be oxidized to form reactive copper ligand-radical species that oxidize the substrate.
Chemiluminescent Probes for in Vivo Hypoxia Detection

Hypoxia is the condition of low tissue oxygenation that is present in various disease states such as cancer and pulmonary disease. Hypoxia arises from solid tumors outgrowing their own vasculature. Hypoxia inducible factor 1 (HIF-1) is a subunit of the HIF-1 heterodimer that is activated in hypoxic conditions. Its binding with HIF-1 affects a multitude of downstream targets including upregulation of reductive enzymes such as nitroreductase to suppress apoptosis and promote angiogenesis in the tumor micro-environment. Current research to detect hypoxia in living systems uses optical dyes sensitive to O2. However, fluorescence-based detection inherently lacks sensitivity due to background autofluorescence, light scattering, and photobleaching effects. Chemiluminescence (CL) overcomes key drawbacks of fluorescence-based imaging through light production by an endogenous source, drastically increasing signal-to-noise contrast while providing high spatiotemporal resolution. Here, we present three CL reporters for in vivo hypoxia detection. HyCL-3 and HyCL-4 detect hypoxic conditions through CL emission in the presence of nitroreductase in the visible and near-infrared regions, respectively. HyCL-5 is a ratiometric sensor that detects O2 levels through resonance energy transfer between the chemiluminescent reporter and an oxygen-sensitive I2 BODIPY fluorophore.

A Novel Insight into Antibiotics Resistance From Enzyme Evolution — Quantitative Analysis of β-lactamases Catalytic Mechanism

The overuse of antibiotics and fast evolution of bacteria with drug resistance in recent years pose serious threat to public health. β-Lactamases are enzymes involved with antibiotics resistance. Understanding β-lactamases’ hydrolysis mechanism could offer a theoretical foundation to predict the evolution of β-lactamases and provide guidance to develop new generations of antibiotics. Representing enzymatic mechanisms as reaction pathways provides structural basis to investigate evolution of β-lactamases catalysis. In this project, catalytic reaction pathways of DD-transpeptidase, penicillin binding protein (PBP) A and two Class A β-lactamases were calculated by hybrid quantum mechanics and molecular mechanics methods within chain-of-states framework. The structures of different states along each pathway of different enzymes were compared and superimposed. The similarity among key structures of different enzymes at the same stage suggests that the reaction mechanism of catalysis is conserved among these evolutionarily correlated enzymes. It is also confirmed that Residue GLU166 in Class A β-lactamases is a crucial residue in β-lactamase catalysis mechanism.

Recovering Intrinsic Fragmental Vibrations Using the Generalized Subsystem Vibrational Analysis

Normal vibrational modes are generally delocalized over the molecular system, which makes it difficult to assign certain vibrations to specific fragments or functional groups of interest. We introduce a new approach, the
Generalized Subsystem Vibrational Analysis (GSVA), to extract the Intrinsic Fragmental Vibrations of any fragment from the whole system via the evaluation of the corresponding effective Hessian matrix. The retention of the curvature information with regard to the potential energy surface in the effective Hessian matrix endows our approach with a physical basis and uniqueness among peer methods. Furthermore, the Intrinsic Fragmental Vibrations have filled the theoretical gap between the theory of local vibrational modes and the normal vibrational modes. We anticipate this approach to be implemented in quantum chemistry packages and used by computational chemists in future.

Rachel Trammell (#36)
Advisor: Isaac Garcia-Bosch
Chemistry, Dedman College

Cu-Direct sp2 and sp3 Hydroxylation

Direct stereo- and regioselective CH functionalizations are synthetically powerful tools for synthesis of org. molecules. In nature, metalloenzymes containing Fe or Cu have mastered the oxygenation process on org. molecule and biological process like DBH and PHM are very well-known dicopper enzymes that couple the reduction of O2 with the oxidation of natural substrates. Inspired by the enzymes, chemists have developed transition metal biomimetic systems that use mild reagents like O2 or H2O2 to oxidize C-H and C=C bonds. In collaboration with Phil Baran, we recently studied the mechanism where Cu(I) and O2 oxidize gamma sp3 CH bonds of steroidal substrates. Based on our studies we improved the reaction cond. by using CuII and H2O2 to create a universal method with remarkable yields (75-99%). In our method (Scheme 1), we can selectively change three features (ketone/amine/oxidant) which allows us to tune the stereoselective properties of the Cu/O2 cores to understand the reactivity of our systems. By changing the structure, we can understand the metalloenzymes that use Cu to carry out CH bond hydroxylation (e.g. PHM and DBH) as well as our systems and apply these methodologies for more synthetic/industrial purposes. In this research presentation, we present our recent findings on the intramolecular hydroxylation of various substrate-ligands containing sp2 and sp3 C-H bonds, Figure1
Correlation Between Molecular Acidity (pKa) and Vibrational Spectroscopy

Acidity characterized by pKa values is an important physicochemical property for any molecular system. The calculation or prediction of pKa is a fascinating yet challenging problem using computational chemistry approaches. In this work, we present for the first time, the direct correlation between pKa values with the local vibrational mode frequencies for eight series of molecules with different substituents. This correlation is discovered as a simple quadratic function of two selected local vibrational mode frequencies as independent variables for each molecule set. The experimental pKa values have been verified for around 230 molecules in this correlation model. The geometry of all molecules was fully optimized and frequency calculated using wB97XD level of theory combined with cc-pVTZ. Using just the two-selected local vibrational modes for various similar groups of molecules, we were able to correlate the pKa values with the root-mean-square error (RMSE) of less than 0.2 pKa units. Because of the versatility and quantity of molecules we used, which are all showing a good correlation between local vibrational frequencies and pKa values, our approach should be general and can be applied to other systems as well.
**Feng Wang** (#38) Co-authors: Peng Tao  
Advisor: Peng Tao  
Chemistry, Dedman College

**Mechanistic Differences Between Class A β-lactamases and Penicillin Binding Proteins Revealed from Molecular Dynamics Simulations**

β-Lactamases are the enzymes produced by bacteria to resist antibiotics such as penicillins and cephalosporins. The abuse of antibiotics leading to fast evolution of β-lactamases results in the antibiotics resistance. β-Lactamases inhibitors could serve as leads to develop new generation of antibiotics. The dynamical interactions between antibiotics and β-lactamases are essential for the function of β-lactamases and could facilitate the development of antibacterial drug design and investigating the catalytic mechanism. TEM-1 and TOHO-1 are classified into class A β-lactamases. Penicillin binding protein A (PBP-A) and DD-transpeptidase are penicillin binding proteins that are evolutionarily related to class A β-lactamases. Understanding the evolutionary relation between class A β-lactamases and PBP including dynamical properties may provide insight into functional differences among these enzymes. In this study, we carried out molecular dynamic (MD) simulations of TEM-1, TOHO-1, PBP-A and DD-transpeptidase, including reactant, intermediate and product states along the reaction pathway. We applied the conformational distributions and Markov states model analysis on the MD simulations. Our detailed analyses provide a new insight into interactions between antibiotics in different catalytic states and enzymes, leading to a novel view on the development of antibiotics and drug design.

**Seth Yannacone** (#39) Co-authors: Daniel Sethio  
Advisor: Elfi Kraka  
Chemistry, Dedman College

**Intramolecular Hydrogen Bonding in Neutral Histidine: Eliciting Bond Strength Using Local Vibrational Modes**

L-Histidine (HIS) is one of twenty essential amino acids involved in biological processes, such as human growth and tissue repair. Biochemists use HIS to purify proteins through ion exchange chromatography, as said molecule is polarizable and shows an affinity for cationic metals such as Ni2+ and Cu2+. In physiological systems, HIS exists in equilibrium between two tautomeric forms which are stabilized by intramolecular hydrogen bonds (IMHBs). To understand the factors involved in this effect, we detailed the relative stability of 6 different HIS conformers in gas and liquid phases. Conformational stabilities in HIS were rationalized via local mode analysis, Natural Bond Orbitals (NBO), Quantum Theory of Atoms in Molecules (QTAIM), and Cremer-Kraka energy density (H(ε)) using the B97XD/aug-cc-pVTZ, B3LYP/aug-cc-pVTZ, and DLPNO-CCSD(T)/aug-cc-pVTZ levels of theory. We found the initial HIS conformer and its enantiomer to be the most stable in terms of the aforementioned methods. Most notably, local mode force constants (ka), number of interactions, thermochemical properties, and NBO populations with respect to the IMHBs of interest correlate directly to structural stability and geometry conformations. Therefore, presence and character of the IMHB networks in HIS play a significant role in stabilizing HIS.
Developing Generalized Network and Community Analysis Methods for Perturbation System

The molecular dynamics simulation is widely used to investigate protein biological functions through the simulation of the protein internal dynamics. One popular way to examine the internal dynamics is the Dynamic Network Analysis method which treats residues as nodes and builds the networks upon them. The correlation metrics are commonly applied to describe the averaged correlated motion between each residue pair. This method is useful in the single state equilibrium simulation, but less significant in comparison between the simulations of two equilibrium states. In the current study, we further developed the Dynamic Network Analysis based on relative entropy (also known as Kullback-Leibler divergence) measured for any pairwise alpha carbon distance distributions. The novel framework of the networks analysis could be applied on any system under perturbations to investigate the distribution changes due to that perturbation. The distance with the highest distribution changes was selected, and the shortest path algorithm was applied to identify the possible propagation path contributed to that particular distribution differences. Therefore, the global distribution differences (>20Å) could be localized into several local distributions propagations (<12Å).

Enhanced Methane and Biogas Generation from Municipal Solid Waste

The solid waste generated in the world is expected to almost double by going from 1.314 billion tons in 2013 to 2.19 billion tons in 2025 according to a World Bank report. This introduces more challenges in our way of collecting, treating, and discarding municipal solid waste (MSW). More than half of the generated MSW in the United States is discarded in landfills. Natural anaerobic biological reactions can be managed in the landfill environment at the right
conditions to result in more waste reduction and landfill gas production (mainly carbon dioxide and methane). Methane is an important gas that can be captured and used for energy. The goals of this research are to investigate methane generation reactions by methanogens and the factors involved to maximize methane generation using experimental and modeling studies. The results of our research are aimed to improve the current practice with anaerobic digestion of MSW. The ongoing research is also addressing the solid waste problems while providing science-based solutions for cleaner, renewable sources of energy for the future.

Commercial Viability: The study investigates experimental and modeling approaches for enhanced methane generation from municipal solid waste, while providing science-based solutions for cleaner, renewable sources of energy for the future.

Sepide Lotfi (#42)
Advisor: Khaled Abdelghany
Civil and Environmental Engineering, Lyle School of Engineering

On-Demand Ride-Sharing Taxi Services for Enhanced Mobility: Problem Formulation and Solution Methodologies

With rising fuel costs and road congestion, ride sharing becomes a common transportation mode. Ride share systems bring together travelers with similar itineraries and time schedules that provide significant social and environmental benefits by minimizing taxi fares for passengers, reducing road congestion, and air pollution. Optimization of ride-sharing services involves solving a complex vehicle routing problems with pickup and delivery with time windows (VRPPDTW) that consists of defining a set of routes to serve passengers that satisfies time window constraints. This poster addresses a variant of the VRPPDTW that provides option for passengers to transfer from one vehicle to another at any location of network. We conclude that in some situations a scheme allowing transfers results in better quality optimal solutions. The problem is formulated as mixed integer program and is solved by using K-shortest route and column generation method. This approach is implemented and compared to solving full problem using CPLEX.

Computer Science and Engineering

Nada Alzaben (#43)
Advisor: Daniel Engels
Computer Science and Engineering, Lyle School of Engineering

End to End Routing Using Max-Flow Min-Cut Based Algorithm

We present a novel max-flow min-cut based algorithms to solve the flow routing problem. Routing using traditional shortest path first algorithms often results in bottlenecks that cause performance degradation including higher energy use, reduced throughput, and increased slowdown. Our algorithm uses max-flow min-cut algorithm to identify potential bottlenecks in order to avoid them in the flow routing decisions. Our simulations show that our max-flow min-cut based algorithm results in 58% increase in mean throughput compared to Shortest Path First algorithm. By explicitly considering congestion in determining routes, performance may be maximized. Concluding that MFMC consider the network congestion explicitly while routing shows how viable it is for routing optimal flows. MFMC is better than SPF by maximizing network throughput. Also, considering the congestions and bottlenecks is critical to develop efficient minimum scheduling.
Minimizing Ancilla and Garbage Qubits in Reversible Function Specifications

As conventional computers continue to get faster and more efficient, they begin to approach their hardware limitations. The upbringing of Quantum Computing gives rise to advances in technology that will solve problems that computers today are not able to solve. One of Quantum Computing’s advantages over Digital Computing is that all logic gates are reversible. This distinct characteristic has led to research in Reversibility Synthesis in both Digital Computer Design and Quantum Computer Design. In this poster, I will be exploring a method, RTT, of creating Reversible truth tables from conventional truth tables in a way that most efficiently uses garbage bits and antica bits. While today we are able to compute small reversible truth tables for some conventional truth tables, this method will make it possible to take larger functions and generate a reversible truth table to reduce energy dissipation in today’s computers, as well as to make it easier to generate Reversible Quantum gates.

Enhancing Cell-Aware Fault Detection through Intelligent Use of Scan Shift Cycles

Probabilistic approaches to the detection of untargeted defects, such as n-detect and standard LBIST (logic built-in-self-test), generally suffer from the need to apply very long test sets to achieve good coverage. However, more targeted approaches that attempt to explicitly model new types of defects, such as cell-aware faults, so that they can be deterministically detected may also lead to unacceptably long test sets. Generally, when tests are applied to circuits that contain scan chains, test results are only captured once the entire pattern has been shifted in and the desired deterministic pattern has been applied. Intervening shift cycles serve only as overhead. This is done because capturing data in the circuit’s scan flip-flops during scan shift would destroy the pattern being shifted in. However, if data is captured in shadow flops in a MISR instead, those shift cycles could be used to obtain additional fault coverage. In this paper, we investigate the ability of the intervening shift cycles to achieve high static cell-aware fault coverage using only the test patterns generated to detect stuck-at faults. We also investigate reducing the number of shadow flops required. Our results show that high cell-aware coverage is achievable even when only a stuck-at test set is applied—in some cases equal to the coverage obtained by a dedicated cell-aware test set.

Using Existing Reconfigurable Logic in 3D Die Stacks for Test

We propose an architecture for an FPGA-based tester for a 3D stacked IC. Our design exploits the underlying structure of the FPGA, allowing it to be used to efficiently store and apply predefined test patterns at a high bandwidth, reducing the FPGA resources required and often reducing the power consumption. Our design can be also utilized to reduce the test response that are important to detect the faults by adding MISR (multi input signature register) structure at the output of the scan chain. The proposed approach and its advantages can generally also be applied to 2.5D multi-die circuits containing FPGAs.
Michael Taylor (#47)  
Advisor: Mitch Thornton  
Computer Science and Engineering, Lyle School of Engineering  

**Ransomware Detection Using Machine Learning and Physical Sensor Data**  

A new method for the detection of ransomware in an infected host during the initiation of its payload execution is proposed and evaluated. Data streams from on-board sensors present in modern computing systems are monitored and appropriate criteria are used that enable the sensor data to effectively detect the presence of ransomware infections. Encryption detection depends upon the use of small yet distinguishable changes in the physical state of a system as reported through on-board sensor readings. A feature vector is formulated consisting of various sensor outputs that is coupled with a detection criteria for the binary states of ransomware present versus normal operation. An advantage of this approach is that previously unknown or zero-day versions of ransomware are vulnerable to this detection method since no prior knowledge of the malware, such as a data signature, is required for this method to be deployed and used. Experimental results from a system which underwent testing with 18 different test configurations comprised of different simulated system loads unknown to the model and different AES encryption methods used during a simulated ransomware attack showed an average precision of 95.27% and an average false positive rate of 1.57% for predictions made once every second about the state of the system under test.

**Commercial Viability:** The new method is comprised of retrieving data from multiple sensors in a computing device, analyzing the sensor data based on a predictive model wherein the predictive model is trained to detect ransomware, and determining initiation of ransomware based on the analysis. In response to the determination, ransomware may be terminated with no previous knowledge of the specific ransomware variant.

Matt Zaber (#48) Co-authors: Derek Phanekham  
Advisor: Suku Nair  
Computer Science and Engineering, Lyle School of Engineering  

**Benchmarking Network Performance in Public Clouds**  

The goal of this work is to provide a foundation of software diagnostic tools for long-term evaluation of tradeoffs in resource placement for public cloud networking features.

**Design and Innovation**  

DiMitri Higginbotham (#49)  
Advisor: Robert Rouse  
Design and Innovation, Lyle School of Engineering  

**Barriers to Equity in Makerspaces**  

Makerspaces provide a safe, creative and resource filled place for makers to create collaboratively. Diversity in makerspaces helps to build a strong maker culture where participants can share varied experiences, skill sets, and interests. This diversity can create equity in high tech STEM fields that have long been inaccessible to marginalized communities. The purpose of my field work was to explore: What barriers exist that prevent equity in makerspaces
and how do makerspaces assess their attempts at promoting diversity? A thorough literature review and design research methodologies were employed to investigate how makerspace directors viewed the meaning for their spaces, if equity and diversity was taken into account, and which methods were used to assess the diversity of their space. Methods included in depth interviews featuring card sorting and prompted drawing exercises. I identified invisible barriers to equity and diversity existed in some makerspaces by way of a narrow curriculum of activities and a narrow definition of outreach which prevents makerspaces from taking advantage of all resources to be offered to a diverse set of communities. As a result, I am presenting a rubric to serve as an assessment tool for emerging and existing makerspaces for creating more equitable and inclusive maker culture.

Keya Tollossa (#50) Co-authors: Tania White, Matt Barkley, Ariel Cabe Martin, Marlene Gomez
Advisor: Katherine Canales
Design and Innovation, Lyle School of Engineering

Transcendent Stories: What Makes the Elderly Feel Alive?

In 2016 there were a reported 45 million Americans who were 65 years and older. As designers, we were interested to learn: "What makes the elderly feel alive as they age?" In this research, our team conducted short and in-depth interviews with 15 different elders across multiple contexts such as malls, restaurants, music festivals, etc. to learn "what makes them feel alive". Often times, our question was met with stories regarding their mistakes, their examples, and their generation/identity. In every context of our interviews, our interviewees chose to teach us (young college students) lessons from their own life. In this way our team observed the sense of catharsis, self-actualization, and feeling needed that could all be realized through sharing stories. This research forced us to consider how we might create a platform for elders to impart experiences, how we can bridge the gap between the young and the old, and how we can encourage meaningful interactions through product design (The Game of Life), college curriculum, and through media.

Earth Sciences

Kimberly DeGrandpre (#51) Co-authors: Teng Wang; Zhong Lu; Jeffrey T. Freymueller
Advisor: Zhong Lu
Earth Sciences, Dedman College

Episodic Inflation and Complex Surface Deformation of Akutan Volcano, Alaska Revealed from GPS Time-Series

Akutan is one of the most active volcanoes in the Aleutian island arc. Studies involving seismic, GPS, and InSAR data have observed activity and deformation on the island since 1996. In this study we invert measurements of volcanic deformation, observed using three components of motions at 12 continuous GPS sites to define magma source parameters using Mogi point source, Okada dislocation, and Yang spheroid and ellipsoid models. In order to analyze the evolution of this magma source we split the GPS data into five consecutive time periods, and one period that incorporates all available data. These time periods are designed around two inflation events in 2008 and 2014, when a sudden and significant increase in vertical velocity is observed. Inversion of these time periods independently allows us to create a magma volume time-series that is related to the physical migration of magma defined by the estimated source parameters. The best fit model parameters resulting from these inversions describes magma storage in the form of an oblate spheroid centered on the northeastern rim of the caldera of Akutan volcano, extending from a
Soil Moisture Influence on InSAR Phase and Coherence

Two SAR images taken at different times combine to make an interferogram aiming to detect ground surface deformations as well as to generate DEMs. The surface parameters between two images are subject to changes; soil and vegetation layer water content changes, vegetation grows and withers, and so on. Despite deformation, the other changes may not be of interest for a common InSAR analysis. The effect of the changes on InSAR phase and coherence can potentially impede accurate estimation of ground surface deformation but also can open new window into soil moisture retrieval and vegetation layer properties estimation.

Kinematic Source Parameter Estimates for Presumed Induced Earthquakes in the Fort Worth Basin, Texas

Since the beginning of oil and gas production in the Fort Worth Basin, there have been five earthquake sequences near the DFW airport, Alze, Irving, Cleburne and Venus. The proximity of these earthquakes to a large population motivates an assessment of possible seismic damages from additional events. Stress drop is one source parameter that is used to assess kinematics of the events. Previous studies have estimated average stress drops for the DFW and Cleburne sequences at 1 and 4.3 Mpa, respectively. This study extends stress drop estimates for all five earthquake sequence. Seismic data are analyzed for all events of magnitude 2.0 and above to ensure adequate signal-to-noise. Brune’s earthquake source model is used to estimate source parameters. Both an absolute approach and empirical Green’s function method are used to isolate source spectra. The results from both methods suggest a departure from self-similarity with increasing moment magnitude. Additionally, these results suggest that ground motion and seismic hazard from an injection-induced earthquake can be expected to be similar to those for shallow tectonic earthquakes. The average stress drop estimates are 2.1 Mpa in absolute calculation whereas a larger stress drops are estimated using the empirical technique. However, both results are consistent with global averages of 1 to 10 Mpa for intra-plate earthquakes.

Yield Scaling of Frequency Domain Moment Tensors from Contained Chemical Explosions Detonated in Granite

The Source Phenomenology Experiment (SPE) was a series of nine contained and partially contained chemical explosions within the porphyry granite at Morenci Copper mine. Ground motion data from the SPE is analyzed in this
study to assess the uniqueness of the moment tensor source representation and its ability to quantify containment and yield scaling. Green’s functions were computed for each of the explosions based on a 1D velocity model developed for the SPE and focused on observations from 37 to 680 m. This study analyzes the three deepest, fully contained explosions with a depth of burial of 30 m and varying yields. Inversions are conducted within the frequency domain and moment tensors are decomposed into deviatoric and isotropic components to evaluate the effects of containment and yield on the resulting source representation. Isotropic moments are compared to other contained explosions as reported by Denny and Johnson, 1991, and are in good agreement with their scaling results. Isotropic and Mzz moment rate spectra are compared to current frequency domain models. Secondary source effects resulting from free surface interactions, such as spall, contribute to the resulting moment tensors and are evident. Our analysis suggests that, within our band of interest, as the frequency increases, the source representation becomes more explosion like, peaking at around 20 Hz.

Yufen Niu (#55) Co-authors: Zhong Lu
Advisor: Zhong Lu
Earth Sciences, Dedman College


Shrub volcano is one of the Klawasi Group which is composed of three large mud volcanoes, located in the Copper River Basin of south central Alaska. Shrub was virtually inactive for decades with only some minor discharge observed in the mid-1950s, and it had three activities in 1996, 1997/06 and 1998/07. We used JERS1, ERS1/2 and RadarSat1 images to produce about 90 interferometric synthetic aperture radar (InSAR) images (interferograms) to study the deformation of the volcano during 1992 and 1998. Two pairs, 1995/09/12–1998/09/19 and 1996/07/17–1998/06/21, show that a circular area about 0.4 km in diameter centered near the summit displaced by as much as 35 cm and 33 cm along the line of sight direction. And the multi-temporal interferograms show that the deformation started at the summer of 1997 and continued to the late of 1998. Furthermore, an elastic Mogi-type deformation model was used to inverse the source’s location, depth and the volume change.

Yuankun Xu (#56)
Advisor: Zhong Lu
Earth Sciences, Dedman College

Detecting Slow-Moving Landslides Over the Southern Oregon using InSAR Time-Series Imagery

As a major geologic hazards, landslides result in 1-2 billion dollars in damages and cause more than twenty-five fatalities each year in the United States. Particularly, over southern Oregon, steep topography, unique geology (e.g., weak serpentine), and intense precipitation during winter seasons frequently give rise to slope failures, even devastating landslides. While a critical and requisite component of landslide hazard mitigation is to monitor landslide movement, just a few landslides in the southern Oregon have been well mapped and studied as these landslide sites are difficult to access due to the steep and brushy terrain. However, synthetic Aperture Radar Interferometry (InSAR), with all-weather and all-time capabilities, can provide critical insights into landslide dynamics in this region. This research aims to detect and characterize landslide motion over the southern Oregon with InSAR time-series measurements, thereby enhancing our understanding of landslide dynamics and the mitigation of landslide hazards.
Weiyu Zheng (#57)
Advisor: Zhong Lu
Earth Sciences, Dedman College

InSAR Detection of Injection Induced Deformation in West Texas

Interferometric synthetic aperture radar (InSAR) is used to detect and measure water injection induced deformation in West Texas. We try to build physics-based model to understand the subsurface process.

Economics

Priyanka Chakraborty (#58) Co-authors: Danila Serra
Advisor: Timothy Salmon
Economics, Dedman College

The Gender Leadership Gap: Does Fear of Negative Judgment Matter?

Decades after the first women took seats on corporate boards and began occupying corner offices, they remain severely under-represented in top executive jobs and in boardrooms. In this paper, we examine an overlooked behavioral constraint that may prevent women from becoming leaders within organizations. In particular, we ask whether women hesitate in becoming leaders knowing that upper-level managerial positions involve the necessity of making controversial employment choices that may generate negative judgment and backlash from employees. We also ask whether gender differences in aversion to social disapproval may lead to differences in the performances of female versus male managers. Finally, we examine whether men and women have different leadership styles i.e. whether they communicate, motivate, evaluate and penalize differently, and whether workers respond differently to a male vis-à-vis a female manager. We employ a novel laboratory experiment where a manager has information about the productivity of his or her employees and has to decide their ranks and their compensations. Managerial decision-making therefore generates inequality among employees. We examine men's and women's decisions to volunteer for the managerial position and test whether their (and especially women's) willingness to lead is lower when employees can send messages of disapproval to the manager.

Debdeep Chattopadhyay (#59)
Advisor: Daniel Millimet
Economics, Dedman College

Did the Massachusetts Health Care Reform Increase Self-Employment?

This poster attempts to contribute to the growing literature on whether employer provided health insurance acts as a barrier to self-employment. The analysis exploits variations in self-employment and health insurance coverage that arose due to the Massachusetts Health Care Reform Law which was passed in April 12, 2006 in the state of Massachusetts to study the effect of the reform on health insurance coverage and self-employment among the residents of MA. Using basic monthly CPS and ASEC data for the years 1999-2010, the study shows that difference in difference (DID) estimates of the effect of the reform on health insurance coverage and self-employment are not reliable as much of the period after the law was passed was affected by the Great Recession which had differential effects on various states in the U.S. and thus violates the implicit “parallel trends” assumption of DID. Using triple difference models on CPS data, the study shows that the reform led to an increase in health insurance coverage and self-employment among the employer insured or uninsured individuals in MA who do not have access to any
alternative sources of health insurance except for employer provided health insurance like coverage through a spouse or the private or public market. The study further observes transitions of individuals from wage/salary jobs to self-employment using matched CPS data.

Yiyi Hu (#60)
Advisor: Bo Chen
Economics, Dedman College

Product Differentiation in Two-Sided Markets

The poster analyzes the horizontal product differentiation in two-sided market. In the dynamic Hotelling model setting, I find that the cross-group externality leads to that one platform is able to steal the loyal consumers from the other platform if the platform choose the certain horizontal product differentiation level. Meanwhile, the price competition is so fiercer that two platforms still choose to maximize the product differentiation level in the equilibrium even though the demand effect is significant in two-sided market due to the cross-group externality.

Kuangli Xie (#61) Co-authors: Ron Cheung; Tim Salmon
Advisor: Timothy Salmon
Economics, Dedman College

Homeowners Associations as a Substitute for Secession

As inequality in major cities worsens one would expect that this could lead to tensions inside cities that might cause wealthy residents to petition for their parts of a city to be able to secede and set up a new city or to merge with an existing suburb that would have more homogeneous demographics. These secessions are rarely observed. While there are many potential explanations for this phenomenon, we investigate the degree to which the rise of Home Owners Associations may have blunted the impetus for secession as well as whether inequity averse preferences could also help explain this lack of secessions.

Kai Zhang (#62)
Advisor: Bo Chen
Economics, Dedman College

A Comparison of Ad Valorem and Unit Tax with Negative Externalities in a Two-Markets Case

Corrective ad valorem and unit tax are compared in a two-markets industry in which one market is generating negative externalities and being taxed. Firms monopolistically compete in each market by producing slightly different varieties. Consumers value both prices and varieties when choosing which market to consume. I show that for an equal-yield tax criterion, unit tax leads to less consumption of the negative-externalities-generating goods than ad valorem tax in both short run and long run. In the short run, the choice between unit and ad valorem taxation regarding total social welfare depends on the relative magnitudes of distortions from imperfect competition and externalities. In the long run, switching taxes does not affect the distortion from imperfect competition. Unit tax is preferred because it leads to less negative externalities. In addition, if tax revenue collected from externalities-generating market is used to subsidize the consumption or production in the substitute market, unit subsidy leads to lower total consumption in the externalities-generating market and higher total social welfare than ad valorem subsidy in the short run. These two subsidies have no difference in the long run.
Education

Kristi Baker (#63) Co-authors: Stephanie Al Otaiba; Patrick Lan
Advisor: Stephanie Al Otaiba
Education, Simmons School of Education

Measuring Teacher’s Knowledge About RTI

This poster reviews the results of a pilot study to determine what types of knowledge teachers need to implement Response to Intervention for their struggling readers. We distributed a survey to 139 elementary schools teachers in four states. We then conducted an exploratory factor analysis to determine the factor analytic structure of the survey. Results revealed that the survey had high internal consistency. Furthermore, the survey highlighted three areas of teacher knowledge about RTI: 1) Tier I instruction, 2) Leadership and School Systems of Support, and 3) Data-Based Decision Making and Interventions. These findings suggest that teachers could benefit from greater support in developing these areas.

Geoffrey Chelule (#64)
Advisor: Candace Walkington
Education, Simmons School of Education

Does Restricting Hand Gestures Impair Mathematical Reasoning?

Gestures are associated with powerful forms of mathematical understanding. However, determining the causative role of gestures in promoting mathematical reasoning has been more elusive. In the present study, we inhibit college students’ gestures by restraining their hands, and examine how this impacts their language, recall, intuition, and mathematical justifications when presented with geometric conjectures. Our intent is to test four mutually exclusive hypotheses: (1) that gestures are facilitative, through cognitive off-loading, verbal support, or transduction, and thus in turn positively influence learners’ problem-solving, (2) that gestures are not facilitative, but being inhibited from gesturing is an effortful process that can increase the cognitive demands of problem solving, (3) that gestures are a byproduct of mental simulations and reasoning processes that would take place with or without the gestures’ overt presence, and have no causative influence on reasoning, and (4) that gestures can cause learners to focus on concrete, salient representations of ideas, inhibiting abstraction and thus mathematical proof. We find consistent support for the third hypothesis, concluding that in the realm of justification of geometry conjectures, learners making or being inhibited from making spontaneous gestures does not impact their problem-solving, cognitive, or language processes.

Carlin Conner (#65)
Advisor: Jill Allor
Education, Simmons School of Education

Case Study of a Child with ASD Responding to a Researcher Designed Text-Centered Literacy Intervention

This case study examines one specific student with autism spectrum disorder (ASD) in his response to a text-centered literacy program. This literacy program uses teacher lessons combined with early readers to teach students how to read. The program is aligned with the four main recommendations found in the What Works Clearinghouse practice guide Foundational Skills to Support Reading for Understanding in Kindergarten Through Third Grade (Foorman et al., 2016). The specific student in this case study was a seven year old, first-grade boy diagnosed with ASD. He has an
IQ of 55, as well as a Peabody-Picture Vocabulary Test age equivalency of 3:04 (Dunn, L. M., & Dunn, D. M. (2007). Peabody Picture Vocabulary Test: PPVT-4A. NCS Pearson.). He also exhibits various other types of externalizing behaviors, making it difficult for him to participate in the general reading curriculum used by his special education teacher. The poster will describe the defining features of the curriculum as well as track the progress of this specific student over time, providing the statistically significant results from his proximal data, obtained weekly over his 21 weeks in the program, as well as results from his distal data, taken periodically over the span of the intervention.

Colin Nelson-Pinkston (#66)
Advisor: Kiersten Ferguson
Education, Simmons School of Education

"The Best Job I Ever Had": An Examination of the Skills Gained by Former Traveling Fraternity Consultants

This study examined the development of men who were members of a fraternity during their time as an undergraduate, who then went on to serve as a traveling consultant for their fraternity. The study examined the college fraternity experiences and fraternity headquarters staff experiences of 33 different men from various backgrounds and provided information on the top skills gained by the sample, providing a provoking case for the traveling fraternity consultant role as a developmental experience.

Kimberly Rutigliano (#67)
Advisor: Ashley Tull
Education, Simmons School of Education

These Relationships Save Lives

My research looks at organizational behavior as a resource to be leveraged for human learning. Two theoretical constructs guided this research, Team Member Exchange theory (TMX) and Social Network Analysis theory (SNA). The data for this research were derived from a case study of a subpopulation of the AMBER organization, specifically the SBI states in Mexico. While no results were statistically significant, there was a weak association between the perceived support on the team (TMX) and the perceived strength of dyadic relationships (SNA) based on measures of outbound degree centrality (r>0.3). Graphical SNA analysis provided a more useful observation for a small group (N=14) than the statistical analysis. Five out of seven nodes with high TMX were located in the core group of the network (71.4%). Those with more and stronger dyadic connections (SNA) also tended to have higher perception of the quality of exchange relationships (TMX). My research demonstrated the exchange relationships working in this organization. The impact of peer relationships in a team has potential applications in both a university and an employer sponsored learning space. In this case, implementation of informed adult education practices brings significant societal value because it serves to improve job outcomes in an industry where much more than profit is at stake. These relationships save lives.
How Might We Understand College Student Engagement in Multiple High-Impact Practices? A Description of Non-Cognitive Behaviors From Student Experiences in the Social Sector

Postsecondary education is increasingly wrestling with tension between its role in cultivating citizens and public demand to prepare workers needed in a changing economy. As policymakers focus on accountability measures, scholars and practitioners emphasize student learning outcomes as an appropriate yardstick to illuminate what students are gaining from their college experience (Kuh, Kinzie, Schuh, Whitt & Associates, 2005; Merisotis, 2016). Specific curricular and co-curricular activities are proven correlates to what students gain from their postsecondary experience, with participation in high-impact practices enabling stronger academic achievement as well as vital cognitive and non-cognitive traits (Astin, 1991; Kuh, 2008; Parker, Kilgo, Ezell Sheets & Pascarella, 2016). This qualitative case study asks (1) how do students’ experiences with multiple high-impact learning practices influence their non-cognitive behaviors, specifically self-efficacy and self-awareness? (Ashley & Reiter-Palmon, 2012; Bandura, 1997; Goleman, 1995; Kuh, 2008), and (2) how might social-sector internships influence non-cognitive behaviors in the context of essential learning outcomes? The study finds that participating students demonstrated more self-efficacious behavior particularly around their confidence working in internships with professional expectations and real-world applications.

Jennifer Stewart (#69) Co-authors: Stephanie Al Otaiba; Stephen Cuillo
Advisor: Stephanie Al Otaiba
Education, Simmons School of Education

Observing Reading Instruction for Elementary Students With or At-Risk for Learning Disabilities: A Synthesis

This poster synthesizes observation studies conducted since 2000 that include reading instruction and intervention for elementary students with or at-risk for learning disabilities (K-5). Fifteen studies met the search criteria; studies were coded and evaluated using quality indicators. Findings, implications, and directions for future research will be discussed.

Min Wang (#70)
Advisor: Candace Walkington
Education, Simmons School of Education

Relationship Between Problem Solving and Problem Posing in K-12 Mathematics Education

The intent of this poster is to provide an overview of the research on problem solving and problem posing, with an emphasis on the relationship between problem solving and problem posing and whether all students are capable of problem posing in K-12 mathematics. The research suggests a positive reciprocal relationship between problem solving and problem posing. Regarding the inclusiveness of problem posing, the research reveals no apparent floor effect in students’ problem posing which means all students were able to participate and contribute in this practice. However, the research indicates that the complexity, originality, and diversity of students’ problem posing can be at a lower level in some situations. Additionally, students’ disposition toward problem solving and posing are often positive but their perseverance and confidence can be only moderate. It is important to investigate older students’
problem solving and problem posing to avoid the floor effect of posing various complex problems, and to develop interventions that not only promote students’ problem solving and posing ability but their perseverance and confidence as well.

**Electrical Engineering**

**Shraddha Birare (#71)** Co-authors: Shraddha Birare; Suraj Nair  
Advisor: Scott Kingsley  
Electrical Engineering, Lyle School of Engineering

**LPWA solution for IoT: LTE-M and NB-IOT**

LTE-M and NB-IoT invented by Third Generation Partnership project (3GPP) in release 13 are two prominent solutions designed which emphasizes low power and wide-area IoT applications. In this paper, discussion of theoretical concepts, evolution of these technologies, technical specifications, deployment strategies, vendor specific network and practical applications, requirements, business benefits of LTE-M and NB-IoT. The authors’ conclusions are also presented.

**Han Gao (#72)**  
Advisor: Carlos Davila  
Electrical Engineering, Lyle School of Engineering

**Computational Theories for Human Stereo Vision**

Stereopsis is the ability to perceive depth. The foremost theoretical difficulty that arises when attempting to understand how the visual system computes disparity is known as the correspondence or matching problem. In this paper, we introduce Gabor filters whose two-dimensional functions have been proven to be good fits to the receptive field profiles of simple cells in the striate cortex to the dynamic computational model we proposed [1, 2]. In this algorithm, feature matrices are obtained by filtering the images with Gabor filters and coincidence detectors which are tuned to different disparities are used to determine disparity values corresponding to pairs of photoreceptors. Our simulation results indicate that Gabor filters can significantly enhance the accuracy of the final disparity map. Further, inspired by the multi-channel filtering theory for visual information processing in the primary visual cortex we demonstrate a feature extraction method based on spatial frequency tuned Gabor filterbank [3]. Features matrices are calculated by subjecting each filtered image to a nonlinear transformation and computing a measure of “energy” in a window around each pixel [2]. And same procedures are used to obtain disparity maps from feature matrices.

**Yueran Ma (#73)**  
Advisor: Carlos Davila  
Electrical Engineering, Lyle School of Engineering

**Linear Phase Multi-frequency Notch Filters via Quadratic Programming**

Discrete-time notch filters have been studied for years and can be divided into infinite impulse response (IIR) and finite impulse response (FIR) notch filters. Infinite impulse response notch filters can are easy to design and implement but suffer from nonlinear phase characteristics and unacceptable startup transients. Finite impulse
response filters on the other hand can be designed to have linear phase but require more coefficients to achieve narrow notch widths. Multiple frequency FIR notch filters that can effectively reject several selected spectral regions while providing high transmission at frequencies outside the rejected regions are widely used in communication systems, radar systems and biomedical signal processing. A new multi-frequency notch filter is introduced that is based on quadratic programming. This notch filter has linear phase and has notch widths which can be made arbitrarily narrow. We compare the performance of our notch filter with three existing multi-frequency notch filters, the iteratively reweighted OMP scheme, the multiple exchange algorithm and the analytical design method for optimal equiripple comb FIR filters.

Muralidhar Madabhushi Balaji (#74) Co-authors: Aparna Viswanath; Prasanna Rangarajan; Duncan MacFarlane
Advisor: Marc Christensen
Electrical Engineering, Lyle School of Engineering

Estimating Motion Around the Corner

There exists several imaging techniques to quantitatively estimate and simultaneously track the motion of objects in the line of sight. However, estimating the motion of objects not in the line of sight is a challenging task. In this work, we present an approach to quantitatively estimate non-line of sight motion by tracking the light return from using a conventional camera. In line of sight motion tracking, the object is illuminated by a source and observed by a detector directly. Whereas, to estimate non-line of sight motion, the hidden object is illuminated and observed indirectly. A laser source illuminates the wall and the scattered light from the wall indirectly illuminates the hidden object. The light scattered back from the hidden object gives rise to random granular pattern at the wall known as speckle pattern as shown in the Figure. A camera imaging the wall is used to record the speckle pattern. For small motions, the speckle pattern moves synchronously with the object. By tracking the motion of the speckle pattern between adjacent frames, very small movements of non-line of sight object is estimated.

Nahid Mirzaie (#75) Co-authors: Ahmed Alzahmi; Chung Ching Lin
Advisor: Duncan MacFarlane
Electrical Engineering, Lyle School of Engineering

Resilient Design of Data Converters Using a Multiple-Objective Transistor Level Approach

The characteristics of 3D stacking in shortening the global interconnects, increasing the bandwidth between dies, and shrinking the footprint have been mainly focused on digital IC design in the previous works. Because of the lack of
efficient design in 3D analog/mixed-signal IC design, this part of our work investigates on novel three-dimensional (3D) architectures for different analog/mixed-signal electronic circuits utilizing through-silicon via (TSV)-induced benefits. We have designed and implemented novel 3D architectures on different circuit structures such as 10-bit pipeline ADC, power delivery network, flash ADC, clock delivery network, and p2p/MD memory interface. In some of our works, we have also implemented memristor ratioed logic (MRL) as the basic elements of the digital sub-blocks to further decrease the area, delay, and power consumption. MRL also can be more promising for advanced technology nodes such as 28nm or 14nm since the memristor devices have less complicated structures than conventional CMOS logics (transistor based logics). Memristor devices are also identified and highlighted as one of the potential candidates for logic applications by the International Technology Roadmap for Semiconductors.

Saeed Mohammadi (#76)
Advisor: Mohammad Khodayar
Electrical Engineering, Lyle School of Engineering

A Convex Relaxation Approach for Power Distribution Network Restoration

Modern distribution networks are facing an increasing number of events that could cause several outages. Distributed generators (DGs) and remote-control switches (RCSs) facilitate prompt system restoration and mitigate the outage periods for the critical loads. The distribution network restoration problem can be formulated as a mixed-integer nonlinear problem. In this research, a convex relaxation approach is proposed to solve this non-convex optimization problem. The effectiveness of the proposed approach is shown in multiple case studies.

Lakshmi Ramakrishnan (#77) Co-authors: Dr. Ping Gui
Advisor: Jennifer Dworak
Electrical Engineering, Lyle School of Engineering

Metric for the Efficiency of DPA-mitigation Techniques Against Hardware Trojan Attacks in Encryption Circuits

Differential Power Analysis (DPA) is an effective technique used to extract the secret key from the side-channel behavior of encryption circuits. In order to counter the effects of DPA attacks, different kinds of DPA-mitigation techniques are used in these encryption circuits. Although DPA-mitigation techniques were created with the intention of protecting encryption circuits from attackers, there is a possibility that these techniques could be used to hide Hardware Trojan Horses (HTHs) in encryption circuits. My research analyzes the effectiveness of DPA-mitigation techniques in hindering the detection of HTHs in encryption circuits.

Bryan Rodriguez (#78)
Advisor: Dinesh Rajan
Electrical Engineering, Lyle School of Engineering

Single View Computer Vision Metrology Using Superquadric Shape Fitting to Time-of-Flight Camera Data with Self-Occlusions and Multipath Interference

Time-of-Flight (ToF) cameras operate by determining how long it takes for emitted modulated lights signals to bounce off of objects in a scene and then return to the ToF camera. The time it takes for the light signal to return to the ToF camera is used to calculate how far away objects in a scene are from the ToF camera. This allows ToF to
generate 3D point cloud representations of objects in the scene. The presence of multipath interference noise and self-occlusions introduces several unique challenges when trying to perform computer vision operations such as performing metrology on objects in a point cloud scene captured by a ToF camera. Multipath interference is caused by interactions between modulated light signals and different surfaces in a scene. When multipath interference is present the point cloud representation of an object becomes distorted. For example, sharp interfaces between different surfaces will appear as smooth transitions between the surfaces. Using a single view to capture a point cloud data for a scene causes self-occlusions for surfaces of an object that are not visible to the ToF camera. Self-occlusion results in a partial representation of the object. We propose a parametric approach that fits superquadric shapes to point cloud data to identify features of an object (e.g. shape and size) in a point cloud scene despite the presence of multipath interfer

Commercial Viability: This research finds applications such as logistics, robot automation, and autonomous vehicles. Computer vision itself allows computer and robots to interpret objects in the real world. This research further extends this capability to allow computers and robots to measure objects in the real world. For example, in a logistics setting the ability to perform computer vision metrology means that packages can identified and measured without physically touching or manually measuring any of the packages. This provides several benefits such as an increased package processing speed which is caused by eliminating the need for manual measurements. This technology provides similar benefits in many other applications.

Pushkar Shirwaikar (#79) Co-authors: Sanket Kosrabe; Smriti Agarwal
Advisor: Scott Kingsley
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Edge Computing

The proliferation of the Internet of Things (IoT) and the success of rich cloud services have pushed the horizon of a new computing model viz. Edge Computing. It is a new technology which is currently being standardized in an ETSI Industry Specification Group (ISG) under the name Mobile Edge Computing (MEC). Edge Computing provides data processing at the edge of the network, within the Radio Access Network (RAN) and near to the mobile device. This technology aims towards reducing latency, ensuring highly efficient network operation and service delivery, and thus offers an improved user experience. Edge Computing is a development in the evolution of mobile base stations and the convergence of IT and telecommunications networking. Being based on a virtualized platform, it is one of the key emerging technologies for 5G networks. Edge Computing, represents a technology and architectural concept to enable the evolution to 5G since it helps advance the transformation of the mobile broadband network into a programmable world and contributes to satisfying the demanding requirements of 5G in terms of expected throughput, latency, scalability, and automation. Edge computing has the potential to address the concerns of response time requirement, battery life constraint, bandwidth cost saving, as well as the data safety and privacy.

Commercial Viability: The environment of Edge Computing is characterized by the low latency, proximity, high bandwidth, and real-time insight into radio network information and location awareness. These values create opportunities for mobile operators, application and content providers enabling them to play complementary and profitable roles within their respective business models and allowing them to better monetize the mobile broadband experience. Edge Computing opens up services to consumers and enterprise customers as well as adjacent industries to deliver their critical applications over the mobile network.
Kaitlin Smith (#80) Co-authors: Mitch Thornton
Advisor: Mitch Thornton
Electrical Engineering, Lyle School of Engineering

**MUSTANG-Q: A Technology Dependent Quantum Logic Synthesis and Compilation Tool**

As quantum information processing devices become a reality, there is increased motivation to investigate and realize methods that enable automated translation of quantum processing algorithms into forms consistent with emerging device libraries. In the past few years there has been some progress in devising automated methods for the conversion of classical irreversible specifications into reversible counterparts, however, the final products of these synthesis procedures are technology independent implementations of algorithms that are not specific to a target technology. In this work, a synthesis and compilation tool, MUSTANG-Q, that maps technology independent forms of quantum circuit operators to a QASM description targeted for a specific physical implementation is presented. MUSTANG-Q is a prototype tool that is capable of serving as an automated quantum circuit synthesis tool for a specific library of technologically dependent quantum operators or “gates." Alternatively, MUSTANG-Q can be used as a compiler for specific implementations of general quantum computers. The IBM Q family of quantum computers are used in this work as example target technologies.

Ali Vafamehr (#81) Co-authors: Mohammad Khodayar
Advisor: Mohammad Khodayar
Electrical Engineering, Lyle School of Engineering

**Intra-hour Operation of Distribution Networks with Volatile Supply and Controllable Data Center Demand**

The emerging distribution networks are equipped with renewable generation resources, controllable loads and corresponding monitoring and control assets to actively regulate the aggregated demand in the bulk power system. The volume of the energy received from the bulk power system as well as the price of electricity contributes to the operation cost of the distribution network. Distribution system operators balance the demand and supply and compensate for the intermittency and variability of the local renewable generation resources and non-controllable loads using the controllable generation and demand assets. Data centers are large flexible electrical loads in distribution networks that could help the distribution system operators to manage the operation cost and to mitigate the imbalance between the demand and generation. The introduced uncertainties in the operation horizon provide economic risks in the distribution network operation. Hence, providing efficient measures for risk associated with the uncertainties provides an insight for the decision makers to avoid over conservative operation decisions. The proposed risk averse operation planning framework constrains the volatility of the expected cost through the conditional value at risk (CVaR) assessment.

Aparna Viswanath (#82) Co-authors: Prasanna Rangarajan; Duncan MacFarlane; Marc Christensen
Advisor: Marc Christensen
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**Patterned Illumination of Objects Hidden Around a Corner**

The inherent nature of real world surfaces to scatter incident light combined with efficient computational techniques makes it feasible to tease out information about objects completely hidden from view of the camera. Borrowing concepts for lensless imaging of geostationary satellites, a non-line of sight computational imager is built to image
these objects. A laser source scattered off a wall indirectly illuminates the object. The camera takes a picture of another part of the wall that intercepts light reflected by the object. The intensity fluctuations that arise from interaction of light with the hidden object is used to reconstruct the image of the hidden object computationally, effectively converting a rough wall into a computational camera. The current work explores new capabilities the system acquires by controlling the illumination incident on the object. A rough surface in the scene is converted into a virtualized pattern projector by creating two focused laser spots on the wall to enable the imager to recognize topological features of the object and to discern its spatial details. Patterning the illumination on the hidden object computationally increases the field of view of the camera as it would now have access to spatial frequencies in the object which were otherwise inaccessible to the camera. Preliminary experiments are currently underway at SMU.

Commercial Viability: The computational imager converts rough walls into virtualized pattern projectors and virtualized detectors to extract spatial and topographic information about an object hidden from view. It finds applications in a myriad of disciplines; from use on unmanned vehicles to looking around a corner in a hallway. The imager equipped with virtualized pattern projector allows indirect measurement of contour, range and topography of the hidden object apart from creating its image. Structuring light illumination on the object enables capture of 3D imagery around a corner, a non-line of sight implementation of the “integrated structured light projector”, a recent invention from Apple.

Guanhua Wang (#83)
Advisor: Ping Gui
Electrical Engineering, Lyle School of Engineering

**A 43.6-dB SNDR 1-GS/s 3.2-mW SAR ADC in 28nm CMOS**

High-speed, medium-to-low resolution analog-to-digital converters (ADCs) are critical building blocks for next-generation 100 Gb/s long-haul optical communication system. Time-interleaving (TI) architecture is a promising way to improve the conversion rate in a given technology. In order to have power and area efficient time-interleaved ADCs, the single channel ADCs must be design carefully. Successive-Approximation-Register (SAR) architecture has been widely used due to its improved power efficiency compare to other approaches. Recent research in SAR architecture also enables it to operate at gigahertz conversion speed.
**Subspace Averaging of Auditory Evoked Potential**

The auditory evoked potential (AEP) is an electric potential generated in the brain in response to auditory stimuli. It has clinical importance in the detection of newborn infant hearing loss. The signal to noise ratio (SNR) of the AEP is low, so signal averaging is typically employed to estimate it. Often, thousands of trials must be averaged before a sufficiently high SNR estimate is obtained. In this research, we have developed a new AEP averaging method called subspace averaging. The subspace averaging method projects onto the signal subspace: the span of the principal eigenvectors of the signal correlation matrix. The signal subspace has low dimensionality and captures the key features of the signal. We compare the variance of the conventional averaging method and the subspace averaging method. The subspace average has less variance and therefore has a higher SNR compared to the conventional average.

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**Unsupervised NILM based on KM-SVM Hybrid Clustering**

With widely installed smart meters and improved data collection technology, per-device load monitoring is gaining increasing attention as it is of great significance in smart building load control, demand response and energy optimization. Recently, a variety of supervised non-intrusive load monitoring (NILM) tools have been developed. However, supervised approaches require detailed prior knowledge of devices, which is usually impractical to obtain and also raises privacy concerns to consumers. Therefore, unsupervised-NILM recently draws more interest. Current unsupervised frameworks either need high-resolution data or are computationally costly, moreover they fail to adapt appliances with multiple operation states. In our work, a fully unsupervised NILM framework based on a k-means (KM) and support vector machine (SVM) hybrid clustering is developed. This method is practical which only needs low-resolution readings (1-minute data) from smart meters, and it is capable of effectively monitoring appliances with multiple states and adapting to new added or discarded equipment. We evaluate our framework with composite sub-meter readings from three houses and compare the results with individual sub-meter, and its effectiveness is verified.

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**85-110 GHz CMOS Tunable Nonreciprocal Transmission Line for Wideband Transceivers**

The first CMOS nonreciprocal transmission line (TL) for wideband tunable full-duplex transceiver front ends, having over 45 dB isolation in a bandwidth of 1.5 GHz and tuning range of 85-110 GHz, is demonstrated. Offering tunable nonreciprocal propagation, this structure is based on a parametric time-varying TL modulated by a 10 GHz signal through distributed capacitive mixing. Two capacitive mixers together with a biasing network form a resonant type of wideband matching. Implemented in a chip area of 0.245 mm2 in 65 nm CMOS, this nonreciprocal TL achieves over 45 dB isolation throughout its entire bandwidth, a maximum 6.5 dB insertion loss (IL) and over 10 dB return loss.
Engineering Management, Information, and Systems

Leroy Ahwinahwi (#87)
Advisor: Eli Olinick
Engineering Management, Information, and Systems, Lyle School of Engineering

Improving the Efficiency of a Hybrid Panel

How to salvage and optimize waste heat to improve energy efficiency.

Yulan Bai (#88) Co-authors: Eli Olinick; Yuanyuan Dong; Junfang Yu
Advisor: Eli Olinick
Engineering Management, Information, and Systems, Lyle School of Engineering

Orienteering Problem Study

The Orienteering Problem (OP), based on a prize-collecting racing game typically played in a forest, is a NP-hard optimization problem with a goal to find an optimal path collecting a maximum total prize within a given time limit. It is widely used in transportation problems and optimal path finding applications. There are two typical OP models: the Fischetti model (based on Dantzig subtour elimination method) and the Gunawan model (based on Miller et al. subtour elimination method). We tested and compared heuristic algorithms and exact methods on benchmark instances using AMPL/Cplex 12.6 and concluded that the Gunawan revised model is much faster than the Fischetti model. Lifted Cover Inequalities (LCI) can be used to improve the performance of a branch-and-cut algorithm in an OP. An effective heuristic algorithm is proposed to find the LCI in LP relaxation of 0-1 integer programs. The triples formulation can effectively accelerate the VRP solving process; it is expected to also improve the traditional OP models and shorten the solving time, which is our future work focus.

Farzad Kamalzadeh (#89) Co-authors: Vishal Ahuja
Advisor: Michael Hahsler
Engineering Management, Information, and Systems, Lyle School of Engineering

An Analytics-driven Approach for Optimal Diabetes Screening Decisions

A lot of money is spent annually on chronic diseases medical care especially for the Diabetes Mellitus. More specifically one out of three dollars of medical expenditure is spent on Diabetes care and treatment. 10 percent of the US population is currently suffering from T2DM and almost forty percent of the population is in the preliminary/pre-symptomatic stage of the disease which soon or late is going to be Diabetes. Screening is the strategy used to identify asymptomatic/pre-symptomatic individuals with unrecognized disease in the general population in order to further treat their disease. Population based screening is an expensive task and thus whom to screen and how often to screen becomes of interest from a decision making point of view. Here Markov decision Process is being used to model the progression of disease in patients and to come up with a set of decisions called as policy in the form of the frequency of the screening for each individual patient. The transition probabilities for the MDP is extracted from the dataset of Diabetic patients available from Parkland Health & Hospital System using Hidden Markov Models. To identify at which state of the MDP a patient is, Naïve Bayes classifier is applied to the dataset to identify the most important risk factors associated with DM. The whole process makes a 2-by-2 framework, categorizing the process into population and individual level.
Cost-Effective Evacuation Network Design under Travel Congestion

We consider an evacuation network design problem under cost and travel congestion considerations while incorporating worst-case evacuation time for the evacuees. Employing a time-expanded network, we model for effective and controlled evacuation by determining active shelter locations and evacuee routes that can be implemented in the preparedness stage in response to foreseen extreme events, such as hurricanes and flooding. Specifically, we propose a mathematical model that prescribes evacuee routes through the road network to shelter locations under evacuation time constraints by making design decisions on shelter locations and capacities, road segments utilized in evacuation and their capacities. To solve our model, we devise an efficient Benders Decomposition (BD) framework with convergence enhancements for solving large-scale instances while also taking advantage of specific characteristics of the problem. We design and implement an experimental study to test our BD technique using data from Central Texas.

Data-Driven Methodologies for Understanding Hospital Congestion in Delivery of Care for Un-/Under-Insured Patients

End-stage renal disease (ESRD) is a catastrophic illness for which dialysis is typically the only available treatment. ESRD patients who are un/under-funded are particularly vulnerable and predominantly rely on safety-net hospitals for their care, typically funded by state or local governments. Since there is no national funding to provide dialysis to this population, their only option is to receive dialysis under emergency conditions, i.e., the acute severity is such that in the absence of immediate medical attention in the Emergency Room (ER), the patient’s health is in serious jeopardy. However, this practice, commonly known as compassionate dialysis leads to severe congestion and treatment delays, thereby imposing a significant health and financial burden, both on patients and the hospital. Motivated by our observations at a local county hospital, we develop data-driven quantitative models and demonstrate that compassionate dialysis leads to severe congestion in ER and subsequent treatment delays for the patient. To this end, we first employ process flow mapping to gain a more thorough and complete understanding of the real-life dynamics of the “compassionate dialysis” process at the hospital as well as to identify inefficiencies and bottlenecks. Next, we combine simulation- and optimization-based methodologies to relieve process bottlenecks.

Optimization Framework for Assessing Impact of Renewable Integration on Gas-Electricity Infrastructure

Integration of renewable energy resources has introduced high level of uncertainty in power systems operations. These uncertainties also propagate into the supply chain of fuels used for electricity generation. This has been
particularly evident for natural gas distribution systems as gas-fired generators are often used to address the intermittent nature of renewable generation. In this research, we present a stochastic optimization and simulation based framework to assess the propagation of uncertainty from renewable generation in power system to natural gas distribution system. We use this assessment to prescribe planning decisions for both the systems which ensure reliable operations in a cost-efficient manner. We present the computational experiment results on the IEEE-30 test system.

Amin Ziaeifar (#93)
Advisor: Halit Uster
Engineering Management, Information, and Systems, Lyle School of Engineering

Relay Network Design and Operations in Truckload Transportation

The truckload industry faces a serious problem of high driver turnover rate, typically more than 100%. Among the major causes of this problem are extended on-the-road times where drivers handle several truckload pickup and deliveries successively, non-regular schedules and get-home rates and low utilization. A strategic design of a relay network that may potentially help to alleviate this issue is studied in this work.

Commercial Viability: The proposed network design framework can be widely used by the US transportation industry to decrease the driver turnover rate and optimize the cost. It is an applicable scheme designed based on real assumptions.

Film and Media Arts

Marlene Gomez Islinger (#94)
Advisor: David Sedman
Film and Media Arts, Meadows School of the Arts

From Physical to Digital - An Empirical Research on Decreased Audience Engagement in the Digital Entertainment Era - A Media Ethical Approach

Existing structures were completely inverted over the last ten years and subject of public discussions. In both the film and television and the music realm a shift from physical to digital could be observed. Records, cassettes, CDs, video cassettes, DVDs and Blu-rays were replaced by online platforms which offer content immediately and without the necessity of a physical device, adapting to TV programming or owning the actual piece of content even though it is already digitized. This change from physical to digital evokes a thesis statement which initiated and leads through this research paper: consumers are so overflowed by the endless choices offered by online platforms with the result that our engagement with the content and its creators generally decreased as they have lost their sense of appreciation for music pieces, films and TV content and their creators. It is assumed that fragmented audiences who have too many choices from too many platforms “suffer” from an oversupply through which the “value” of media content dwindles away in consequence of a decreased audience engagement. The notion “media value” implies the appreciation of and thoughtful conduct with entertainment content and its creators. After a self-elaborated definition audience engagement implies attachment to entertainment content and its creators in form of appreciation and thoughtful conduct.
Guildhall

Conor Dalton (#95) Co-authors: John Slocum; Elizabeth Stringer
Advisor: Mark Nausha
Guildhall

The Five Dynamics of Highly Successful Teams and Their Relationship with Team-Efficacy and Team Performance

Surveys were administered to assess team-efficacy and internal team dynamics, which were measured by Google’s re:work, for free software product that develops teams over six iterative cycles. Team performance was analyzed to look for a relationship between the measures of team-efficacy and Google’s five dynamics, and team performance. The goal of this study is to provide tools to measure the five dynamics and team-efficacy, and if relevant to team performance, to enable future researchers to develop strategies for using their elements to make their teams more effective. The study found there was a significant correlation between the five internal team dynamics and team-efficacy. The study also found there was a significant correlation between the five dynamics and team performance, as well as team-efficacy and team performance.

Commercial Viability: Forming team is a regular occurrence for many individuals in their daily routines. Hardly a moment or experience passes without some group of individuals coming together with a common goal to complete tasks. In a highly collaborative industry like software product development and video game design, team leaders and project managers are always seeking ways to improve the performance and potency of their teams. The value of this study for software product development and the video game design industry is that it gives team leaders tools to measure team-efficacy and internal team dynamics. In a study of three teams over six periods of time, we found that team-efficacy and internal team dynamics are significantly related to team performance. This study also shows what tool should be used in what instance, and gives suggestions on how future research could be performed to further understand team-efficacy and internal team dynamics.

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Dylan Fansler (#96)
Advisor: Corey Clark
Guildhall

Dynamic Remeshing of Ductile Materials on the GPU

This project simulates the elastoplastic deformation of a mesh with a focus on ductility. The foundation of this approach is based on the work of Martin Wicke, et.al. To decrease processing overhead for video games, a 3D model that has no internal vertices is used instead of the tessellated models used in the foundational work. Additionally, a system of GPU algorithms is used to run the simulation using Compute Shaders. This allows for off-loading internal memory constraints on the model’s initial load and for the simulation to run with multiple instances at once in real-time.

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Andrew Fulsom (#97)  
Advisor: Corey Clark  
Guildhall  

Procedural City Layout Generation Using WaveFunctionCollapse and Google Maps  

Procedural generation of complex man-made systems such as cities represents a significant challenge due to the large number of factors that influence their formation and growth. Procedural city layout applications, such as CityEngine, use techniques that require a large amount of input data from users, while more recent, patch-based approaches to city layout generation offer simpler to use, example-based techniques but have some limitations to their expressive range or still require some specialized knowledge from users. This paper proposes a technique for procedurally generating the layout of cities using WaveFunctionCollapse(WFC) with only a single example image. Using images from Google Maps as input, WFC allows a new city layout to be generated similar to the input city. This allows users to provide examples of city layouts without specialized knowledge or data. By only using patterns that exist in the example city image, WFC avoids the need for knowledge that influenced the city’s formation. The new layout is visualized in 3D using Unreal Engine 4 and C++. By using different input images, this technique can generate a variety of city layouts, ranging from highly grid-aligned to more organic. We demonstrate this using source images of Dallas and Milan to create grid-based and organic city layouts respectively.

Alejandro Hernandez (#98)  
Advisor: Corey Clark  
Guildhall  

NPC Emotion Modeling Using the OCC Model, Five Factor Model, and Social Relations  

Representing NPC emotions in games from a psychological standpoint can give characters realistic behaviors. This paper proposes an NPC Emotion Model that incorporates the OCC Model, Five Factor Model, and social relations together to emulate realistic behaviors. This model is similar to others like the MAMID architecture however, the MAMID architecture places more emphasis on the effects of anxiety within the model. The NPC Emotion Model presented in this paper is also in almost direct contrast to COR-E, which attempts to produce emotional behaviors without the use of emotion variables. The OCC Model provides the foundation of the NPC Emotion Model, generating 10 different basic emotions for NPCs based on situations that happen. The Five Factor Model, or Big Five, makes up a NPCs personality. Every NPC also has social relations with others determining their affiliation with others. These social relations, situations, and personality modify the intensity of the emotion generated. The emotional state of the NPC and their social relations with others dictate the behavior that NPCs perform. The model was implemented into a predator and prey simulation. Each predator and prey are NPCs with social relations and a random personality. A set number of behaviors were created for NPCs and their emotions dynamically change over time using the model presented here.

Wenzheng Huang (#99)  
Advisor: Corey Clark  
Guildhall  

Using Computer Vision to Identify Player Inputs on Street Fighter 5  

This poster introduces a replay analyzer for Street Fighter V that extracts players’ input commands by analyzing a replay video or image sequence with computer vision. Multiple approaches are tried and cascade classifying is chosen.
Cascade classifiers are trained with OpenCV library and game footages. The analyzer outputs timestamps and the input occur at each timestamp in the replay. This analyzer is currently for Street Fighter V only, but with appropriate sample data, it can extend to any games. This poster demonstrates the process of preparing sample data and shows results of analyses.

Stephen Merendino (#100)
Advisor: Corey Clark
Guildhall

Physically Based Rendering

Physically Based Rendering (PBR) is a rendering methodology that seeks to produce virtually rendered images in a way that is based on the real world physics of light and materials. Due to the ability to represent several different types of materials using a standard set of parameters and its ability to decouple lighting from material appearance, it has become the standard in high quality real time rendering techniques. This poster examines the theory behind PBR with a focus on the Bidirectional Reflectance Distribution Function (BRDF).

John Nguyen (#101)
Advisor: Corey Clark
Guildhall

Adapting a Multiplayer RPG Client-Server Video Game to a Decentralized Game-Based Volunteer Computing Network

Large scale multiplayer video games require large computing resources to handle server-side processing such as but not limited to: client synchronization, game logic, and matchmaking. Building and maintaining these services can be costly and prevent indie developers and small studios from producing large scale multiplayer video games. Previous research has shown that embedding a volunteer computing network (VCN) inside of video games can crowdsource the computing infrastructure needed for building many of the backend services required for large scale multiplayer video games. Using distributed computing in video games is not new, but was limited to computations for the current game being played. By creating a general-purpose computing infrastructure through crowdsourcing, developers can use their current active user base to support deployment of new titles and backend services. This research goes through the process of adapting a native multiplayer RPG client-server video game into a distributed application that is deployed across the HEWMEN decentralized game-based volunteer computing system (GBVCS). This research also discusses strategies around topics such as memory, computing capacity, security, performance, serverless architecture and consensus in decentralized environment for the deployed video game.

John Wilson (#102)
Advisor: Corey Clark
Guildhall

Horror Movie AI Personalities using Behavior Trees and Multi-Agent Based Modeling

This poster focuses on the creation of a simulation that demonstrates a Multi-Agent AI framework with horror movie personality tropes (Jock, Cheerleader, Nerd, Stoner, Goth, Ingenue) using a decision tree for their actions. The AI’s goal is to escape a haunted house where a crazed killer is chasing them. The AI have fourteen personality traits
(Ambition, Rebelliousness, Extroversion, etc…) that are taken from the Comrey Personality Scales and the Hogan Personality Inventory. Alongside the differing personalities, the AI uses a Multi-Agent approach, wherein the agents use the same initial behavior decision tree framework. The actions they take along the tree are determined by the weights given to their personalities. These traits have a weight from 0 to 1 depending on how true the trait is to the given trope and depending upon the given weight for each trait. The AI's behavior differ from one another affecting such factors as what exits it will take, which AI will become the leader when it meets another helpful AI, and whether they run away or toward the killer. This poster highlights how these multiple AI agents have been modeled by the personality indexes to end up favoring one of the haunted house’s five exits and when put in a situation with multiple friendly AI and one unfriendly killer, the AI’s code will work together and in turn access previously unused exits.

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**Tianyi Zhao (#103)**
Advisor: Corey Clark
Guildhall

**Reinforcement Learning Agent for StarCraft II Mini-game**

This poster uses image-based interfaces that mimic a human's experience to build deep reinforcement learning agents to play several StarCraft II mini-games. The agents are implemented by two different learning algorithm: Asynchronous Advantage Actor-Critic (A3C) algorithm and Deep Q-Learning (DQN) algorithm. We use two different neural network architecture to train the agents. We give the result of each training process and compare the performance of different agents.

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**International Studies**

**Silvia Rivera**
Advisor: Eva Csaky
International Studies, Dedman College and Cox School of Business

**The Case for Handmade**

As stated by the Artisan Alliance, “the artisan sector is the second-largest employer in the developing world after agriculture, worth over $32 billion every year. Hundreds of thousands of people across the globe, particularly women, participate in the artisan sector. Artisan activity creates jobs, increases local incomes, and preserves ancient cultural traditions that in many places are at risk of being lost.” In other words, handmade artisanal products have a significant potential for social impact, both in terms of the income they generate and the cultural traditions they help preserve. Unfortunately, and despite a growing global marketplace for high value, socially conscious products, an overwhelming amount of artisan businesses and organizations continue to struggle for the basic recognition, tools and resources they need to succeed. My research's main objective is to better understand the global market for artisanal products, the related value chain and the market failures faced by artisans and the organizations they work with, including organizations in D/FW that work with artisans in developing countries.
Mathematics

James Barrett (#105)
Advisor: Vladimir Ajaev
Mathematics, Dedman College

The Effect of Electrostatic Forces on the Evaporation of Liquid Droplets

The current study seeks to understand the effects of electrostatic forces on liquid droplets deposited on heated substrates. The mathematical model uses the axisymmetric thin film approximation considering the effects of surface tension, evaporation, thermocapillarity, gravity, London van der Waals disjoining pressure, as well as electrostatic forces. The electrostatic forces are added by incorporating the Poisson-Boltzmann equation under the Debye-Hückel approximation and measured by the electric Weber number. We find that increasing the electric Weber number leads to a decrease in evaporation time as the interface and therefore evaporative flux changes.

Jiahui Chen (#106)
Advisor: Weihua Geng
Mathematics, Dedman College

On Preconditioning the Treecode-Accelerated Boundary Integral (TABI) Poisson-Boltzmann Solver

We design a scheme using a preconditioning matrix to reduce the condition number of the matrix generated from Boundary Integral Poisson-Boltzmann equation. In this scheme, the preconditioning matrix carries the interactions between boundary elements on the same leaf only thus is block diagonal with many computational advantages.

Brian Citty (#107)
Advisor: Thomas Hagstrom
Mathematics, Dedman College

The Wave Problem on a Finite Domain with Stochastic Boundary

In this poster we analyze the simple wave equation on a finite domain. Outside the domain we model the wave speed as a stochastic variable and we seek to find the effect this has on the solution in the finite region in terms of the boundary conditions. First, we will discuss how to model the situation and arrive at a stochastic differential equation. Next, we will show how various numerical techniques can be employed to solve the problem, and finally we will show numerical results.

Austin Copeland (#108)
Advisor: Alejandro Aceves
Mathematics, Dedman College

Photonic Crystal Fibers with a Twist

Light confinement can occur during the propagation through a twisted photonic crystal fiber (a chiral fiber). In the absence of a twist, the modal profile is assumed known from Bloch theory. By use of averaging techniques applied to ray theory, we attempt to describe the optical path length leading to confinement. Alternatively, we also explore the
problem using field theory described by the linear Schrödinger equation. We show that an increase in twist rate will result in more confined modes.

Yu Hu (#109)  
Advisor: Amnon Meir  
Mathematics, Dedman College

Weak Form of Governing Equations for the Coupled Electromagnetics and Acoustics of Porous Media

In this poster, the quasi-static state of governing equations for the coupled electromagnetics and acoustics of porous media will be studied. The weak form of the equations will be given as well as a priori estimates, which can lead to the proof of uniqueness of solution.

Sasan Mohyaddin (#110)  
Advisor: Johannes Tausch  
Mathematics, Dedman College

Solution of a Time Fractional System of Homogenous KDV Equations by the Modified Extended Tanh Method

In this poster, a new traveling wave solutions have been established by using the modified extended tanh method for time fractional nonlinear systems. By employing the method, soliton solutions are obtained for different types of time fractional systems, such as time fractional two–component evolutionary systems of a homogenous KDV equations of order two and three. Based on a fractional complex transform and the properties of modified Riemann–Liouville derivative, both systems are reduced to ordinary differential equations. The exact solutions for these systems are plotted at different time levels.

Enrique Pereira Batista (#111) Co-authors: Barry Lee  
Advisor: Barry Lee  
Mathematics, Dedman College

Nonlinear Multigrid for the Solution of Nonlinear Power Flow Equations

Power flow models are given by a system of nonlinear equations describing the flow of electric energy through a power grid network. These models are extensively used to analyze the state of large power grids. The practical relevance of solving this system of equations arises from the continuously changing structure of power grids through the inclusion of emergent energy sources and deregulation of electric markets. Fast and robust solvers for this system is an active area of research given the many possible scenarios on which a power grid operates on. In this poster we explore a new fast and robust technique to solve the system.
Jennifer Swenson (#112)
Advisor: Scott Norris
Mathematics, Dedman College

Analytical and Numerical Studies of Swelling as a Stabilizing Mechanism in Irradiated Thin Films

Irradiation of semiconductor surfaces often leads to the spontaneous formation of rippled structures at certain irradiation angles. However, at high enough energies, these structures are observed to vanish for all angles, despite the absence of any identified, universally-stabilizing physical mechanisms in operation. Here, we examine the effect on pattern formation of radiation-induced swelling, which has been excluded from prior treatments of stress in irradiated films. After developing a suitable continuum model, we perform a linear stability analysis to determine its effect on stability. Under appropriate simplifying assumptions, we find swelling indeed to be stabilizing at all angles for wavenumbers typical of experimental observations. Therefore, this mechanism may account for the vanishing ripples observed at high energies.

Duc Truong (#113)
Advisor: Andrea Barreiro
Mathematics, Dedman College

Cell Assemblies Detection

Cell assembly is a group of neurons working together. The existence of these assemblies will help us to identify how, and which part of, the brain responds to different experimental settings. We have relaxed some assumptions of Russo's method, and applied to fear conditioning data from Xu Lab. The results show the existence of some biologically meaningful assemblies.

Ting Yan (#114)
Advisor: Daniel Reynolds
Mathematics, Dedman College

Reaction-Diffusion Model of Drug Concentration in a Lymph Node

We discuss a novel computational model of viral dynamics in the lymph node, to allow numerical studies of viral "reservoirs" causing reinfection once drugs are stopped (including HIV and Ebola). Our model consists of a system of reaction-diffusion partial differential equations (PDEs), where the diffusion coefficients vary between species (virus, drugs, lymphocytes) and include discontinuous jumps to capture differing properties of internal lymph node structures. In this poster, we present the mathematical model and discuss our current work on implementing this using the FEniCS finite-element infrastructure, including parallel results on Maneframe2 using both OpenMP and MPI.
Anyu Zhang (#115)
Advisor: Brandilyn Stigler
Mathematics, Dedman College

Partitioning Data Using Monomial Bases to Improve Network Inference in Systems Biology

In systems biology, network inference is plagued by too few input data and too many candidate models which fit the data. Finite dynamical systems offer a viable solution as the model space can be described by a monomial basis. The problem of selecting a model can be reduced to selecting an appropriate basis. Recently affine transformations were shown to partition input data into equivalence classes with the same bases, and data sets configured as a staircase are associated with a unique basis. We wrote a python package incorporating parallel computation to build the equivalence classes for small networks. We developed a metric to measure how far a data set is from being a staircase and propose that a data set configured as a staircase is in standard position. Using this metric, we defined the representative of an equivalence class in terms of its distance from a staircase and showed that representatives are unique. We are currently focusing on computing the number of equivalence classes and the size of each class based on the number of data points, variables, and network states. The implication of this work is guidance for systems biologists in designing experiments to collect data that result in a unique model, meaning a unique set of predictions. This has the potential to reduce ambiguity in modeling and improving predictions.

Lu Zhang (#116) Co-authors: Daniel Appelo; Thomas Hagstrom
Advisor: Thomas Hagstrom
Mathematics, Dedman College

An Energy-Based DG Method for Second Order Wave Equations

In this work, we investigate the wave equation with background flow by a new discontinuous Galerkin method. The method defines inter-element fluxes in a direct, mesh independent way. It can be either energy conserving or energy dissipating, depending on a simple choice of the numerical fluxes. We also carry out rigorous analysis to obtain a priori error estimates in the energy norm for certain fluxes and provide some numerical simulations to show the optimal convergence rate in L2.

Mechanical Engineering

Noah Bartos (UG) (#117)
Advisor: Paul Krueger
Mechanical Engineering, Lyle School of Engineering

Rocket Motor for Sounding Rocket Applications

All components of a solid rocket motor were developed and tested. Fuel characteristics were validated for the Sugar-Potassium Nitrate blend, motor hardware was designed and developed, and a static test of the motor was performed. The motor was designed to have 500 lbf, 4,500 N-s of impulse, and burn for around three seconds. Finalization of testing is ongoing, scheduled to be completed in late February.
Jaime da Silva (#118) Co-authors: Benjamin Wise; Elie Salameh
Advisor: M. Volkan Otugen
Mechanical Engineering, Lyle School of Engineering

Computational Design and Optimization of Doppler Shift Sensors

This project aims to develop and optimize a coupled ring micro-resonator waveguide system as part of a novel miniature velocity sensor. The sensor is based on detecting the Doppler shift of scattered light from a targeted object. Power loss from coupling remains a main concern in this sensor design, and thus improvements on light coupling configurations are suggested and presented. Several iterations of multi-mode and single-mode fiber coupling techniques are studied, with the incorporation of single-mode waveguide to ring micro-resonator. The FDTD software MEEP is employed in the sensor design to assess output signal strength and resonance quality factors. A parametric study of multiple geometric aspects, including coupling distance, ring thickness, and number of output signal modes, is performed for this purpose. The Doppler shifts required are modeled through external perturbations in the ring evanescent field and will be further addressed in future sensor iterations.

Ahmad Gad (#119) Co-authors: Xin-Lin Gao
Advisor: Xin-Lin Gao
Mechanical Engineering, Lyle School of Engineering

A 3D RPIM Meshless Model for the Solving Micropolar Linear Elastic Deformations with Surface Interface Effect

In this manuscript, we propose a new computational model to predict the behavior of general 3D structures obeying the linear theory of micropolar (Cosserat) elasticity while considering the surface elasticity effect as described by Gurtin & Murdouch (GM) model. The computational model was based on meshfree radial point interpolation method which was based on the principle of minimum total potential energy. The model is used to solve several problems in the 3D elasticity such as inclusion problem and deformation of a bi-material strip. The obtained numerical results were found to match the theory and previously obtained results obtained for simple problems. It was also clear that the micropolar effect as well as the surface energy effect appears only when the structure size is small enough that the surface as well as the micropolar part of the bulk energies are comparable with the classical part of the bulk energy.

Ataollah Gogani Khiabani (#120)
Advisor: Ali Heydari
Mechanical Engineering, Lyle School of Engineering

An Optimal Controller Based on Approximate Dynamic Programming for Single-Phase Zvoltage Source Inverters

In this study, an optimal control method based on approximate dynamic programming is proposed to convert a DC voltage to a single phase AC voltage. The control scheme uses a single function approximator, called critic, to evaluate the optimal cost and determine the optimal switching. The critic is tuned once offline, as a function of the system states and elapsed time, and the results are used for feedback control, to get a desired output AC voltage. Simulations show that under both linear load and highly nonlinear load, the desirable output voltage is achieved. Furthermore, relative robustness of the controller is shown in simulations. Moreover, with some alterations in the
structure of the critic, grid synchronization is acquired. Finally, as one of few ADP-based studies, the results are tested experimentally, through a physical implementation.

Assaad Helou (#121) Co-authors: Archana Venugopal; Dhishan Kande
Advisor: Peter Raad
Mechanical Engineering, Lyle School of Engineering

Thermal Characterization of Si BEOL Microelectronic Structures

Resistor reliability rules are defined by certain electrical parameters that depend on operating temperature. As shown by Black’s Equation, a temperature change of 5°C can lead to a 30% reduction in expected lifetime. The temperature rise of a resistor depends on its dimensions and thermal properties as well as those of surrounding materials that separate the resistor from the heat sink. In this study, a modified approximate model based on Schafft’s equation is developed to estimate the operating temperature and assess the reliability of BEOL micro-resistor structures. The additional contribution of the substrate thermal resistance is added to the model and validated through a combined approach of experimental thermal mapping and numerical modeling. The developed analytical and numerical models are validated with the experimental temperature maps and could then be used for parameterization to aid the BEOL design process.

Yongqiang Li (#122)
Advisor: Xin-Lin Gao
Mechanical Engineering, Lyle School of Engineering

Modeling of Head Injuries Induced by Golf Ball Impacts

Head injuries induced by golf ball impacts are studied through computational modeling. A full human body model and a three-piece golf ball model are integrated to construct a new finite element model, and LS-DYNA is employed to perform simulations. To assess head injury risks, the impact force, von Mises stress, pressure, and first principal strain are computed in the current model and compared with existing experimental and simulation data. The frontal impact of a golf ball on a human head at an impact velocity of 35 m/s is taken as the baseline case and studied first. The simulation results reveal that no skull fracture can happen, while mild traumatic brain injuries may take place. The effects of impact location, velocity, and angle are then investigated. Three impact locations (i.e., frontal, lateral and crown) are considered. The impact velocity is changed from 15 m/s to 76 m/s, and the impact angle is adjusted from 90-deg (normal) to 45-deg (oblique). It is found that the lateral (right) impact leads to higher risks of skull fracture and brain injury than the other two impact locations. Also, it is observed that the impact force, the maximum von Mises stress in the skull, and the pressure and first principal strain in the brain increase with the increase of the impact velocity or the impact angle.
Poured Razzaghi (#123) Co-authors: Ehab Al Khatib
Advisor: Yildirim Hurmuzlu
Mechanical Engineering, Lyle School of Engineering

Biped Robot

Two leg biped robot is proposed. The three flywheels are used to balanced and generated the torque for walking. By using this new mechanism in walking robot, we do not need to put the actuator in the joints. The robot is built and the nonlinear control is applied on the system to walk smoothly.

Tohid Sardarmehni (#124)
Advisor: Ali Heydari
Mechanical Engineering, Lyle School of Engineering

Sub-Optimal Switching in Anti-Lock Brake Systems using Approximate Dynamic Programming

Optimal scheduling in anti-lock brake system of ground vehicles is performed through approximate dynamic programming for reducing the stopping distance in severe braking. The proposed optimal scheduler explicitly incorporates the hybrid nature of anti-lock brake system and provides a feedback solution with a negligible computational burden in control calculation. To this goal, an iterative scheme, called value iteration algorithm, is used to learn the infinite horizon solution to the underlying Hamilton-Jacobi-Bellman equation. Performance of the proposed method in control of the brake system is illustrated using both linear-in-parameter neural networks and multi-layer Perceptrons. Simulation results demonstrate potentials of the method.

Benjamin Wise (#125) Co-authors: Jaime DaSilva; Elie R. Salameh
Advisor: M. Volkan Otugen
Mechanical Engineering, Lyle School of Engineering

An Improved Compact Atmospheric Speed Sensor for Mars Missions

We are developing a laser velocimeter which operates by illuminating atmospheric particles, collecting scattered light, and measuring the Doppler shift of the scattered light to determine the airspeed, or relative velocity between the aircraft and particles. This instrument is designed to eliminate pitot-static tube systems, and similar devices, which have severe limitations at high altitude and at super- and hyper-sonic conditions. Improvements include replacing the key Doppler shift measuring devices, a Fabry-Perot Interferometer and a CCD camera imager, which are very sensitive to vibrations, as well as physically bulky and heavy (both detrimental to use on spacecraft), with whispering gallery mode micro-resonators, which are more robust, much smaller, and lighter, and offer a conservative theoretical measurement sensitivity gain of over one order of magnitude. We present improvements to the data analysis algorithm and the physical design, including the elimination of several significant sources of signal loss.
Nima Yazdian (126) Co-authors: Masoud Mohammadmour
Advisor: Radovan Kovacevic
Mechanical Engineering, Lyle School of Engineering

Hybrid Laser/Arc Welding of Thick AISI304 Stainless Steel Tube in Orbital Joint Configuration

Single-pass deep penetration hybrid laser arc welding (HLAW) of 8 mm thick AISI 304L stainless steel tubes with diameter of 280 mm was conducted by using a high-power disk laser combined with a gas metal arc welding machine. First, the effects of scanning speed as well as heat source arrangement on the weld integrity and pore mitigation were investigated. Then, the thermal simulation of the pipe girth welding using ANSYS was carried out to identify the heat distribution throughout the weld. Finally, the microstructural and mechanical attributes of the optimal weld were characterized by scanning electron microscopy (SEM), micro-hardness, and tensile test, respectively. The results showed that high welding speed along with the application of arc-push mode not only generated a visually sound weld but also significantly mitigated the number of keyhole-induced or gas-caused pores. The proposed heat source model for thermal simulation resulted in isotherms that were relatively consistent with the cross section of the weld for the arc-push and arc-pull modes. From the microstructural point of view, it was observed that the amount of d-ferrite that was decomposed at the arc zone of the weld was proportional to the cooling rate. Therefore, the arc-pull mode with the higher cooling rate led to the formation of a large amount of d-ferrite.

Gongye Zhang (127)
Advisor: Xin-Lin Gao
Mechanical Engineering, Lyle School of Engineering

Band Gaps for Elastic Wave Propagation in a Periodic Composite Beam Structure Incorporating Microstructure and Surface Energy Effects

A new model for determining band gaps for elastic wave propagation in a periodic composite beam structure is developed using a non-classical Bernoulli–Euler beam model that incorporates the microstructure and surface energy effects. The Bloch theorem and transfer matrix method for periodic structures are employed in the formulation. The band gaps predicted by the new model depend on the microstructure and surface elasticity of each constituent material, the unit cell size, and the volume fraction. To quantitatively illustrate the effects of these factors, a parametric study is conducted.

Commercial Viability: These periodic structures can stop wave propagate at certain frequency ranges (i.e., band gaps), which have potential applications such as frequency filters, vibration isolators and energy harvesting devices.

Physics

Dan Jardin (128) Co-authors: Ray Bunker
Advisor: Jodi Cooley
Physics, Dedman College

Characterization of a High-Sensitivity Radon Emanation System

Radon is a problematic background source for rare-event searches such as dark matter direct detection and neutrinoless double-beta decay experiments, and radon emanation is one of the most sensitive and robust screening methods. A system for low-level measurements has been commissioned at the Pacific Northwest National Laboratory
(PNNL) that achieves high sensitivity through use of custom high-efficiency ultra-low-background proportional counters (UHBPC). The emanation system and detection method will be described, and characterization of backgrounds and efficiencies using a calibrated radon source will be shown.

James Thomas (#129) Co-authors: Payton Price; Lezly Murphy; ZhengGuang Wang; Chehby Rhoades; Nianchen Feng; Mary Lena Bleile; Daniel Sela; James Kay; Elijah Cruda; Emily Baker; Dr. Jingbo Ye; Dr. Tiankuan Liu (Andy); Chufeng Chen; Wei Zhou; Taite Lozano-Brown; John Harrison Ray; Xiandon Advisor: Jingbo Ye
Physics, Dedman College

Development and Implementation of Quality Assurance and Reliability Assurance Methods Used on Two ASICs for the Phase 1 Upgrade to the ATLAS Detector at the LHC

Although it is currently the world’s most powerful physics experiment, the Large Hadron Collider (LHC) will be upgraded in the coming years. Along with the upgrades to the LHC, the ATLAS detector will also be upgraded to be able to better handle the immense amounts of data generated. One of the upgrades to the ATLAS detector to be completed during the phase-1 upgrade is to the trigger used at the Liquid Argon (LAr) calorimeter. To achieve the objectives for this update, the trigger readout of the current system will be changed to a fully digital readout board called the LAr Trigger Digitizing Board, or LTDB. These boards will include the optical links as well as the laser drivers and serializers/encoders. Each LTDB will have 40 optical fibers and each fiber will transfer data at 5.12 GB/s. The single channel speed as well as the total data throughput through these boards is unprecedented in current high energy physics experiments. As a part of this upgrade process, SMU is responsible for the development and construction of two Application Specific Integrated Circuits (ASICs) as well as two optical modules. I have developed and implemented a quality assurance/reliability assurance program used to ensure the proper functionality of the ASICs.

Psychology

Talha Alvi (#130) Co-authors: Chrystyna Kouros; Benjamin Tabak Advisor: Benjamin Tabak
Psychology, Dedman College

Social Anxiety is Associated with Decreased Empathic Accuracy for Positive, but not Negative, Stimuli

Individuals with social anxiety disorder often have cognitive biases that interfere with accurate perceptions of others' thoughts; yet, there is little research exploring the relation between social anxiety and empathic accuracy (EA). The present study examined the effect of social anxiety on EA, and the extent to which this association was moderated by the emotional valence of stimuli. Undergraduate students (N=269) completed measures including the Social Phobia Scale (SPS) and then participated in an EA task which contained both positive and negative videos. Multilevel modeling was used to account for repeated assessments within participants. There was a significant interaction between SPS and emotional valence of videos in predicting EA, b=-.0022, SE=.0006, p<.001. Simple slopes analyses showed that higher levels of social anxiety were associated with lower EA for positive stimuli (p<.001), but not negative stimuli, (p=.95). Results were maintained when statistically controlling for participants' neuroticism, extraversion, and dysphoria, as well as actors' expressivity in videos. Findings suggest that social anxiety may impair EA, but only for positive emotional stimuli. One potential explanation is that individuals with higher levels of social
anxiety are more sensitive to negative evaluations, which may contribute to a heightened misperception of positive stimuli.

Grace Boyers (#131) Co-authors: Lorelei Simpson Rowe; Brian Baucom
Advisor: Lorelei Simpson Rowe
Psychology, Dedman College

Patterns of Change in Relationship Satisfaction among Veterans in Couple Therapy

Couple therapy ameliorates relationship distress for many couples, but not every couple benefits or maintains improvements. As a result, there have been several calls to identify the processes by which couple therapies effect change, so that treatments can be better understood and then modified to be more effective, but few have been clearly established. The goal of the proposed study is to examine patterns of change in relationship satisfaction in two samples of couples who received treatment-as-usual at two Veterans Affairs couple therapy clinics. The proposed study will add to previous research by examining within and cross-partner effects of session-by-session change in relationship satisfaction over the course of treatment using dynamical systems analysis (DSA). DSA has advantages over traditional modeling techniques in its ability to explain dynamic and complex therapeutic change processes (e.g., Salvatore, Tschacher, Gelo, & Koch, 2015). Although DSA has been used to investigate change processes in other areas, the proposed study will be the first known application of DSA in analyzing processes of change in couple therapy. DSA analyses for this project are currently in progress; I will present the final results and discuss their implications for both researchers and practitioners of couple therapy.

Chelsea Carson (#132) Co-authors: Grace Boyers; Lorelei Simpson Rowe
Advisor: Lorelei Simpson Rowe
Psychology, Dedman College

Correlates of Empathic Accuracy Among Couples in which a Partner has a Severe Mental Illness

Empathic Accuracy (EA), or the extent to which an individual can correctly infer their partner’s thoughts and feelings, is associated with relationship quality in couples. We examine three potential correlates: emotion recognition, psychiatric diagnosis, and relationship satisfaction in individuals with a severe mental illness (referred to as patients), and their spouses (referred to as partners). We hypothesized that emotion recognition and relationship satisfaction would be positively associated with EA, but that psychiatric diagnosis would be negatively associated with EA. We examined EA for happiness and anger. Sixty couples engaged in two interactions. After each, partners reported their own and their partner’s emotions during the conversation. Consistent with hypotheses, relationship satisfaction was positively related to EA for happiness in partners, and emotion recognition was positively related to EA for anger in partners. Interestingly, partners demonstrated significantly less EA for anger compared to controls. Relationship satisfaction was negatively related to EA for anger in partners and positively related to EA for anger in patients. The findings provide further support that severe mental illnesses impair emotional competencies within relationships, and suggest that social cognition skills may be especially important in understanding a partner’s anger.
Bree Geary (#133) Co-authors: Austin Baldwin
Advisor: Austin Baldwin
Psychology, Dedman College

Unpacking the Intention-Behavior Gap During the Initiation of Regular Exercise

Many people intend to change health behaviors but fail to take action on their intentions – known as the “intention-behavior gap”. In this study, we addressed the following questions: (a) How prevalent are planned but not completed (skipped) exercise sessions? (b) Do different types of motivation at initiation predict frequency of skipped sessions? (c) Are the reasons cited for skipped sessions consistent with those motivations? Physically underactive adults (N=87) enrolled in an exercise intervention and were instructed to engage in regular aerobic exercise. At baseline, participants self-reported two types of motivation: autonomous motivation and controlled motivation. During the first week of the intervention, participants reported daily exercise behavior including whether an intended exercise session was completed or skipped. The number of skipped sessions was regressed simultaneously on autonomous and controlled motivation, controlling for intervention condition. Overall, 56% of participants reported at least one skipped session. Both autonomous and controlled motivation significantly predicted the number of skipped workouts. Results suggest skipped exercise sessions are prevalent during the first week of regular exercise initiation, and autonomous and controlled motivation predict a decrease and an increase, respectively, in the number of skipped exercise sessions.

Patricia Gower (#134)
Advisor: George Holden
Psychology, Dedman College

The Spillover Effect? Links Between Interparental Conflict, Parent-to-Child Yelling, and Anxiety in College Students

The spillover hypothesis posits that interparental conflict increases harsh discipline, which may have negative implications for child mental health. We hypothesized that interparental conflict would be associated with parent-to-child yelling and mental health problems in college students. A sample of 276 college students (F=74.3%, Mage=19.48 years) was recruited from a Southwestern metropolitan city. Retrospective reports were collected using the Conflict Tactics Scale (CTS) and the Experiences with Parental Yelling Questionnaire (EPYQ), and concurrent reports were collected using the State-Trait Anxiety Inventory (STAI). To examine the relationship between interparental conflict, parent-to-child yelling, and anxiety, correlational analyses were conducted. Interparental conflict was positively associated with the mother-to-child yelling r(136)=.52, p<.001, and father-to-child yelling, r(136)=.40, p<.001. Mother-to-child and father-to-child yelling were positively associated, r(136)=.50, p<.001. Students' anxiety was positively associated with interparental conflict, r(136)=.21, p=.013, mother-to-child yelling r(171)=.27, p<.001, and father-to-child yelling, r(171)=.24, p=.001. These findings provide some support for the spillover hypothesis. Despite uncertain directionality, interparental conflict and parental yelling are likely to have an adverse impact on mental health.
Anni Hasratian (#135) Co-authors: Alicia Meuret; Michael Chmielewski; Grace Boyers; Thomas Ritz
Advisor: Alicia Meuret & Thomas Ritz
Psychology, Dedman College

An Examination of the RDoC Negative Valence Systems Domain: Populating the Self-Report Unit of Analysis with Established Measures

The current categorical diagnostic classification system poses problems like reliance on fixed disorder definitions, frequent co-morbidity, and heterogeneity within disorders. In response to these shortcomings, NIMH proposed the RDoC initiative to move towards a dimensional approach using translational research. The current study examines associations between validated measures of negative affect and subsystems of the negative valence systems (NVS) domain. We examined how self-report units of analysis reflect constructs of responses to acute threat (fear), potential harm (anxiety), and sustained threat, frustrative non-reward, and loss proposed by the RDoC NV workshop. Participants were 313 students who completed 17 validated and established self-report questionnaires that assess fear, anxiety, stress, frustration, and depression. We conducted a principle component analysis of questionnaire and subscale scores with rotation to simple solution using Varimax. The identified factors reflect major aspects of RDoC positive and NVS domain, particularly panic/fear, anxiety/worry, chronic stress, frustrative non-reward, and reduced behavioral activation. More work is needed on mapping measures onto NV subsystem of loss, which could be captured by depression/low well-being scales but could also be conceptually close to the positive valence system of low approach-motivation.

Emily Johnson (#136) Co-authors: Grace Boyers; Lorelei Simpson Rowe
Advisor: Lorelei Simpson Rowe
Psychology, Dedman College

Childhood Victimization Experiences and Assertive Resistance among Emerging Adults

About 50% of American women experience at least one incident of sexual violence (U.S. Department of Justice, 2006). Sexual victimization is associated with increased risk of future victimization (Classen et al., 2005) and is mediated by assertive resistance (Kelley et al., 2016). Using assertive resistance skills increases the likelihood of escaping sexually coercive situations (Ullman, 2007). Unfortunately, sexual abuse co-occurs with other forms of victimization (Finkelhor et al., 2007). Polyvictimization may increase vulnerability to future victimization through common mechanisms, including assertive resistance. In the current study, we tested whether polyvictimization is negatively associated with assertive resistance in response to unwanted sexual advances. 59 female college students reported on childhood victimization and adult sexual victimization and participated in a virtual reality simulation of sexual coercion. Trained coders rated participants’ assertive resistance behavior in response to aggressive sexual coercion. Contrary to expectations, only childhood physical maltreatment (CPM) was positively related to assertive resistance. Additionally, CPM and CSA interacted such that those who experienced both engaged in the highest levels of assertive resistance. This suggests a potential curvilinear relationship between assertive resistance and victimization.
Claire Krizman (UG (#137))
Advisor: Chris Logan
Psychology, Dedman College

Depression, Stress, and Anger: Association with Coercive Discipline

Numerous studies examine parental depression, stress, and anger, and how each individually relates to parental use of coercive discipline. For example, Eamon (2001) found that maternal depression was related to physical parenting practices (i.e. spanking), claiming to be due to hostility and irritability associated with depression. Studies on parental stress show that stress can lead parents to engage in less reflection but more autonomic information processing and coercive discipline practices (Crouch & Behl, 2001). Anger has also been shown to be associated with the use of physical discipline practices (e.g. Kolko, 1996). However, there is a limited amount of information on the effects of a combination of depressive symptoms, stress, and anger on coercive discipline. In this study, we predicted that parents who report high levels of depression, stress, and anger will report higher levels of coercive discipline.

Divya Kumar (#138)
Co-authors: Noelle B. Smith; David Rosenfield; Michael Treanor; Halina Dour; Thomas Ritz; Michelle Craske; Alicia Meuret
Advisor: Alicia Meuret
Psychology, Dedman College

For Better or For Worse: Examining the Temporal Dynamics of Positive and Negative Affect

Affect is often divided into two components: positive affect (PA) refers to the extent to which a person feels enthusiastic, active, and alert, while negative affect (NA), is the converse feelings of anger, fear, and contempt. We compared temporal dynamics of PA and NA in two samples: 84 anxious/depressed individuals and 104 undergraduate students. Affect ratings, measured via the Positive and Negative Affect Schedule, were assessed weekly for 15 weeks in the clinical sample and 5 weeks in the student sample. The former participated in a transdiagnostic psychological intervention for affective disorders. Cross-lag mediational analyses were utilized to examine relations between changes in PA and NA. In the clinical sample, lower than average PA predicted higher NA at the next session (B = -0.07, p = .026), controlling for concurrent NA, and higher than average NA predicted lower PA at the next session (B = 0.07, p = .023), controlling for concurrent PA. Similar dynamics were observed in the student sample, in which lower PA related to greater NA at the next time point (B = -0.05, p = .02), but not vice-versa. These findings provide support for a sequential relationship between these two affective dimensions across time and indicate that modifying PA to reduce NA could be a helpful treatment target.

Hannah Nordberg (#139)
Co-authors: Juliet Kroll; Matti Miller; Yumna Furqan; Alexis Jones; Thomas Ritz
Advisor: Thomas Ritz
Psychology, Dedman College

The Influence of Lifestyle Factors in the Affective Response to Sustained Acute Stress

Staying physically active, prioritizing sleep, and reducing chronic stress has been linked to improvements in physical and mental health. The extent to which these factors influence individuals’ affective response to stressors however, has not been thoroughly examined. In this study, undergraduate students (n = 265) were assessed at mid-semester, during a final exam period, and following the exam period. We hypothesized that participants’ reported physical activity levels, chronic stress, and sleep habits would predict their perceived stress, negative affect, and expectations of mastery during the exam period. Multiple linear regression models controlling for demographics and BMI
indicated that a longer duration of sleep the night before an exam assessment predicted lower negative affect and stress responses during the exam period. Additionally, greater levels of reported chronic stress during mid-semester predicted greater negative affect during the exam period. Sex was a significant predictor of performance satisfaction following the exam period, indicating that women are more satisfied with their final grades. Contrary to expectations, physical activity levels were not significant predictors of negative affect, perceived stress, or expectations of mastery. Our findings indicate an important role of prior sleep in predicting the affective response to sustained acute stress.

Michael Ovalle (#140)
Advisor: Chrystyna Kouros
Psychology, Dedman College

Transmitting Psychopathology from Depressed Parents to Their Offspring

Child psychopathology is widespread. One factor consistently related to child psychopathology is parental depression. Goodman and Gotlib (1999) proposed four primary mechanisms and one subsequent vulnerability that act as sequential pathways between maternal depression and child mental health outcomes. Highlighting these underlying processes is crucial for intervening in this transmission. The objective of the current review is to provide a comprehensive investigation of the mechanisms of transmission between parental depression and child mental health. Specifically, we focus on two Goodman and Gotlib (1999) mechanisms—exposure to negative maternal cognition, behavior, and affect, and exposure to a negative family environment—and subsequent child vulnerabilities in our review. Our aim is to establish support for Goodman and Gotlib’s (1999) proposed sequential pathways, for alternative pathways, and for non-sequential mechanisms implicated in the literature. Seventy-two longitudinal studies were identified. Twenty-six percent of studies tested mediation through a sequential pathway, of which four found an indirect effect through a proposed sequential pathway. Conversely, three studies found support for an alternative sequential pathway. The most supported non-sequential mechanism was exposure to a negative family environment. Limitations and future directions are discussed.

Caitlin Rancher (#141) Co-authors: Caitlin Rancher; Renee McDonald; Laura Minze; Nicole L. Vu; Kelli S. Sargent; Ernest Jouriles
Advisor: Ernest Jouriles
Psychology, Dedman College

Evaluating a Project Support Module to Increase Supportive and Responsive Parenting

Responsive parenting is an important predictor of child adjustment; yet, most parenting programs are lengthy and present barriers (financial and time) to families. Few attempts have been made to dismantle intensive interventions into discrete modules. Project Support is a 6-month parenting program found to improve parenting quality and reduce child adjustment problems. We condensed three Project Support parenting skills (attending, listening, comforting), into a 2-3-session module, to pilot whether positive outcomes could be achieved with such an approach. Participants, 73 mothers and their 6 to 12 year-old child, were randomly assigned to either the Project Support module or a waitlist control condition. Assessments were completed at pre-treatment, post-treatment, and 1-month follow-up. Controlling for pre-treatment levels, mothers who received the Project Support module reported improved communication and lower levels of harsh parenting at post-treatment, and children reported greater mother-child relationship quality and lower depression symptoms at the 1-month follow-up, compared to families in the control condition. These results provide initial evidence that a very brief, modular approach to delivering Project
Support might be useful for the field. This research holds important implications for the development and dissemination of brief, yet flexible, parenting programs.

Catherine Rochefort (#142) Co-authors: Michael E Bowen; Jasmin Tiro; Molly McQuire; Austin Baldwin
Advisor: Austin Baldwin
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Sending Patients Diabetes Screening Test Results: Effects on Changes in Comparative Risk and Worry and Information Seeking Behavior

Diabetes screening presents an opportunity for healthcare providers to intervene; however, how patients respond to diabetes test results is unknown. Adult patients in a safety-net health system were asked to participate in a longitudinal diabetes screening study. At enrollment, interviewers administered comparative risk and worry items in English or Spanish. Then, participants (N=302) were screened for diabetes and mailed results (i.e., normal, prediabetes). After screening, participants answered items on comparative risk, worry, and diabetes information-seeking behavior. Two-week survey response rate was 59% (n=179). Change in comparative risk did not differ between those with a normal (n=107) or prediabetes (n=72) result, F(1, 176) = .41, p = .52. However, prediabetic patients had greater increases in worry, F(1, 176) = 4.20, p = .04, d = .31, and were more likely to seek diabetes-related information (49%) than those with normal results (31%), x²(1) = 5.77, O = .18, p = .02. Neither changes in comparative risk nor worry were associated with information seeking in either group (ps >.10). These findings suggest that receiving test results leads to important affective and behavioral responses among patients and may be a timely opportunity to engage patients in diabetes prevention efforts.

Andres Roque (#143) Co-authors: Alicia Meuret; Halina Dour; Michael Treanor; Michelle Craske; Thomas Ritz
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The Association of Depression with Cortisol Reactivity to Laboratory-Induced Stressors in Individuals with Affective Disorders

Background: Research has shown that the stress response of those with mood disorders may be altered; specifically, cortisol hyper- and hypo- reactivity have been observed in individuals with depression. The aim of the present study is to further examine the effects of depression on cortisol reactivity to laboratory-induced stressors. It was expected that those with higher depressive symptoms would have a stronger cortisol reactivity to stress. Methods: Twenty-one participants underwent stress induction tasks which included a mental arithmetic task and a fear potentiated startle task where participants were threatened with an electric shock. Cortisol levels were collected at four time points. Regression analyses were used to examine associations between cortisol reactivity and levels of depressive symptoms. Results: Controlling for basal (evening) levels of cortisol, time of day, gender, and age, those with higher levels of depressive symptoms had stronger cortisol responses. Conclusion: The stronger cortisol responses in those with higher depressive symptoms are in agreement with recent studies across populations including adolescents (Morris et al., 2017) and asthma patients (Trueba et al., 2016). These findings suggest that those with higher depressive symptoms have a hyper-reactive stress response which over time can be detrimental to other health outcomes.
**Margarita Sala (#144) Co-authors: Catherine Rochefort; P. Priscilla Lui; Austin S. Baldwin**
Advisor: Austin Baldwin
Psychology, Dedman College

**Mindfulness and Health Behaviors: A Meta-Analysis**

We conducted a meta-analysis to determine the magnitude of the relations between mindfulness and health behaviors and to identify moderators of these relations. The resulting database contained 113 independent samples in the 115 studies included in the meta-analysis, from which a total of 979 effect sizes were coded. We used multilevel modeling analyses. Mindfulness was positively associated with health behaviors, and specifically with physical activity, healthy eating, safe sex, increased sleep and avoidance of alcohol use and drug use (rs = .06 -.12, ps = .001 -.05). In addition, there were several key moderators. First, the relations between mindfulness and health behaviors were stronger in clinical samples (rs = .19-.40, ps < .001) than non-clinical samples (rs = .06-.10, ps < .001). Second, the mindfulness facet of acting with awareness was the most reliable predictor of health behaviors (rs = .06 -.16, ps < .01). Finally, the relations were more robust when health behavior was assessed via self-report measures (rs = .08-.09, ps < .001) than objective measures (rs = .03-.06, ps = .06-.76). Findings from this meta-analysis revealed a positive relationship between mindfulness and health behaviors and identified various moderators of this relationship. Research and clinical implications will be discussed.

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**Kelli Sargent (#145) Co-authors: Lindsey Wilson; Will Bartels**
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**Adolescent Dating Violence Perpetration, Resistance to Negative Peer Pressure, and General Antisocial Behavior**

Up to 25% of youth report perpetrating sexual or physical dating violence. Youth who report greater susceptibility to negative peer pressure are more likely to enact relationally or sexually aggressive behaviors with partners. Negative peer pressure may increase the likelihood of antisocial behavior, which can facilitate dating violence perpetration. Thus, antisocial behavior was hypothesized to mediate resistance to negative peer pressure and dating violence perpetration, controlling for baseline levels of variables. Participants completed self-reports and virtual reality simulations involving negative peer pressure. VR responses were coded for resistance to peer pressure. Participants returned for a 2-month follow-up. 13% reported at least one act of violence perpetration in the past 2 months at baseline, and 9% did so at follow-up. 36% and 29% reported at least one delinquent act in the past 2 months at baseline and follow-up respectively, the majority of which was smoking marijuana. VR resistance was related to dating violence, controlling for baseline perpetration, b = -.169 p = .05. T2 antisocial behavior mediated this link, controlling for T1 perpetration and antisocial behavior 95%CI[0.021, 0.414]. Interventions targeting resistance to negative peer pressure broadly may show promise for reducing a variety of negative behaviors, including dating violence perpetration.
Margaret Smith (#146) Co-authors: George Holden  
Advisor: George Holden  
Psychology, Dedman College  

Does an Attachment Parenting Program Moderate Maternal Warmth, Discipline, and Child Behavior Problems?

It is well recognized that parental warmth and discipline are related to child adjustment problems. However, it is unclear how an attachment-based parenting program (API) affects these relations. We predicted maternal warmth and non-coercive discipline would be associated with fewer behavior problems. We hypothesized that participation in API would moderate the effects. API mothers participated. Then, API mothers were matched with a comparison group on age, race, education, income, child age, and child sex. Preliminary analyses indicated group so each matched characteristic was controlled for. Maternal warmth was significantly related to child internalizing symptoms, \( B = -0.17, t(410) = -4.06, p < .001 \), such that increased maternal warmth is associated with fewer internalizing symptoms. This relation was significantly moderated by API, \( B = 0.16, t(410) = 2.23, p < .03 \). The interaction showed an enhancing effect. Mothers’ reported use of coercive discipline was significantly related to child internalizing symptoms, \( B = -0.21, t(410) = 3.83, p < .001 \). API did not significantly moderate that effect. Use of non-coercive discipline was not significantly related to internalizing symptoms. The results demonstrate that API enhances the relation between warmth and internalizing symptoms. A second finding was that maternal coercive discipline was related with children’s behavior problems.

Natalie Tunnell (#147) Co-authors: Thomas Ritz; Alicia E. Meuret; Ashton Steele; Noelle Smith; Meara Weitzman  
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Association of Emotion Dysregulation and Experiential Responding During Stress Induction

Emotion dysregulation is hypothesized to play an important role in treatment outcomes and is considered a risk factor for multiple psychopathologies. The goal of this study was to investigate the extent to which difficulty in emotion regulation predicts negative affect, arousal and subjective distress across clinical and non-clinical samples. Participants were 81 individuals who met criteria for Non-Suicidal Self-Injury (NSSI, N=25), high difficulty in emotion regulation (DERS, N=27) and healthy controls (HC, N=29). Participants completed diagnostic interviews and laboratory assessments, which included the Trier Social Stress Test (TST) and quiet sitting (QS). Experiential ratings, including subjective units of distress, arousal and negative affect, were completed following each task. Analyses indicated that
emotion regulation significantly predicted peak subjective units of distress (p=.008) and negative affect (p=.016) during the TSST when controlling for group. More difficulty with emotion regulation yielded higher levels of distress and negative affect, regardless of group. Arousal during the TSST, however, was unrelated to emotion regulation difficulties. Overall, the results suggest that emotion dysregulation and experiential responding interact, thus supporting the important role of emotional reactivity during high stress situations for all individuals.

Sharyl Wee (#148) Co-authors: Michael Ovalle; Chrystyna Kouros
Advisor: Chrystyna Kouros
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Family Stress and Children’s Adjustment: Skin Conductance Level Reactivity as a Moderator

The family environment is a robust predictor of children’s adjustment; yet, not all children exposed to stressful family environments are negatively affected. Studies show that children’s skin conductance level reactivity (SCLR) to stress—a marker of sympathetic nervous system reactivity—increases risk for adjustment problems. In contrast to previous studies which assessed child SCLR in response to problem-solving tasks or actor-simulated conflict, we examined SCLR in response to children’s own parents’ conflict, and tested SCLR as a moderator of the relation between family stress and child adjustment. We expected higher SCLR to exacerbate and lower SCLR to attenuate the relation between family stress and child adjustment problems. Participants were 55 children (M age=13.5, SD=1.80; 52.7% girls) and their parents. Children reported on family stress and mothers reported on their child’s adjustment. Children’s SCLR was measured in response to watching a video of their parents’ conflict discussion. Regression analyses revealed a significant interaction between family stress and child SCLR in predicting child externalizing symptoms, b=0.42, p=.003; higher SCLR exacerbated the relation between family stress and externalizing symptoms, whereas lower SCLR buffered children. The findings support that higher SCLR in response to family stress increases children’s risk of adjustment problems.

![Figure 1. Relation between family stress and mother-reported child externalizing symptoms moderated by children’s skin conductance level reactivity (SCLR). Simple slopes plotted at ±1 and ±1 SD from the means for family stress and SCLR.](image-url)
Experiential Avoidance in Asthma Predicts Quality of Life and Asthma Control

Research on experiential avoidance (EA) in medical populations suggests a relation to quality of life. Avoidance of asthma-related cues could complicate self-management of the disease. This study aimed to explore the utility of a brief asthma-specific measure of EA and examine its relation to quality of life, asthma control, and other clinical outcomes. 476 asthma patients and their physicians completed questionnaires about their medical history, compliance, asthma triggers, experiential avoidance, mood symptoms, quality of life, asthma control, and patient satisfaction. Exploratory PCA resulted in a single factor, 7-item measure of EA in asthma that had adequate internal consistency (Cronbach’s α = 0.85). Multiple regression analyses showed that this questionnaire predicted asthma-related quality of life, general quality of life, asthma control, number of exacerbations in the past year, and number of emergency visits. Higher experiential avoidance predicted less asthma control, more exacerbations and emergency visits, and poorer general and asthma-related quality of life. The current study presents a brief, 7-item measure of EA specific to asthma, which shows adequate internal reliability and relations with clinical outcomes such as quality of life and asthma control. These relations suggest that examining an asthmatic’s EA may prove informative in their overall health care.

Bayesian Classification with Hierarchical Tensor Decompositions

We consider the problem of Bayesian hierarchical conditional probability tensor factorization. A conditional probability tensor describes the chance of an event given the occurrence of multiple other dependent events. This problem is particularly of interest for multidimensional contingency tables, which can be regrouped into a tensor of counts for each joint event. Without strong assumptions, working with such a tensor is problematic due to the intricate dependencies in the underlying process. However, recent work proves such conditional factorizations can be decomposed intuitively by probabilistically clustering each conditioned random variable, significantly reducing the dimension of the problem in an interpretable manner. For multiple groups of counts, the group identification can be included in the tensor factorization. When multiple groups exist more than one generative process may exist, but the current formulation would cluster without taking this into account. We propose a Bayesian hierarchical formulation which allows for random effects of individual group processes and shared information across each group. We illustrate the usefulness of this hierarchical formulation through simulation and a real world data analysis.
Sample Size Calculation of Repeated Count Outcomes with Overdispersion

Randomized clinical trials with count measurements are common in various medical areas. Controlled clinical trials commonly assign subjects randomly to one of two treatment groups and repeatedly evaluates them at baseline and intervals across a treatment period of a fixed duration. The primary interest is to compare the rates of change between treatment groups. Generalized estimating equations (GEEs) have been widely used because of its robustness to misspecification of the true correlation structure. Negative binomial regression is commonly used to model count outcome due to its flexibility of taking over-dispersion into consideration. In this paper, we derive sample size formulae for comparing the rates of change between two groups in a repeatedly measured count outcome assuming negative binomial distribution and using GEE method. Two types of negative binomial distributions are considered to address different over-dispersion patterns. The sample size formulas incorporate general missing patterns such as independent missing and monotone missing, and general correlation structures such as AR(1) and compound symmetry. Distribution selection criterion based on QIC are derived for the two types of negative binomial distributions so that a distribution selection can be performed when a pilot data set is available.

Extrapolation of Causal Estimates from Clinical Trials

The population in which one conducts a clinical trial often differs from the population for which the novel treatment can be applied. If the treatment effect varies by covariates whose distributions differ between the trial population and the target population, the treatment effect estimate from the trial may be biased. We propose a method to extrapolate causal estimates from a clinical trial to reflect the distributions of stratification factors in the general population. We assume that participants in the clinical trial are similar to those that are not included in the trial, other than on a set of factors that are measured in the study and whose distribution in the population is known. We compute estimates of treatment effects in strata defined by these factors, and reweight the estimates to match the distribution in the target population. The idea is applicable to both the standard intention-to-treat estimate and the instrumental variables estimate that adjusts for nonadherence, and one can adjust for both discrete and continuous covariates. We demonstrate our method in the Coronary Primary Prevention Trial (LRC-CPPT), whose age distribution did not match the age distribution in the general population.

Practical Approaches of Incorporating Big Data Sources into Survey Practice

Probability sampling framework has been served as the dominant paradigm for most of the survey practice over the past decades. However, this standard procedure is facing challenges such as the increasing cost and declining response rate. On the other hand, as in the era of “Big Data”, large amounts of data source are available in many forms especially from the internet, these are known as nonprobability samples. Nonprobability samples are faster and easier
to collect compare to a standard probability sample. Another characteristic of these “Big Data” sources are the absence of clear selection mechanism for each in-sample unit. Directly usage of the convenience “Big Data” sources should be cautious as they could bias the statistical inference easily. One alternative is to combine different sample sources by developing pseudo-weights for the nonprobability sample and use it to augment the probability sample, as with a dual frame design. Relying on the real census data, the purpose of this study is to compare different approaches of developing pseudo-weights and provide practical suggestions on how to combine different data sources. The methods are then applied as alternatives to the currently used one for a survey conducted by National Marine Fisheries Service (NMFS) as demonstration.

Ram McShane (#154)
Advisor: Ian Harris
Statistical Science, Dedman College

CRSP: Modeling Stochastically Intransitive Relationships between NBA Teams

If the Warriors beat the Rockets and the Rockets beat the Spurs, does that mean that the Warriors are better than the Spurs? Sophisticated fans would argue that the Warriors are better by the transitive property, but could diehard Spurs fans make a legitimate argument that their team is better despite this chain of evidence? We attempt to answer whether the assumption of transitivity in pairwise comparisons should hold by modeling without the assumption. Applications of pairwise comparisons reach far beyond sports. Examples include ranking political candidates, selecting a Pope, experimentally predicting animal behavior, and exploring dominance relations within or among species. We focus on the setting where all pairs of items, teams, players, or objects have been compared to one another twice. We propose a novel linear model (CRSP) whose latent bilinear fixed effect allows us to estimate deviations from our transitive model (C). We discuss the mathematical details of the model, including an eigendecomposition that enables an estimate of the latent bilinear fixed effect. We also propose a generalized version of the bilinear fixed effect and demonstrate an application thereof.

Robert Sickorez (#155)
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Statistical Science, Dedman College

Inverting Moment Generating Functions

In applied probability computation, working with moment generating functions in the transform domain instead of density functions in the time domain allow us to obtain exact functional forms with relative ease. The drawback is the need to invert the resulting moment generating function to obtain the desired probability value. This is difficult when the functions are not rational, in which case we must use numerical methods to approximate the inversion integral along an infinite contour in the complex plane. Available methods integrate along the Bromwich contour, which runs parallel to the imaginary axis to the left of all singularities. Quadrature methods are slow to converge due to the periodicity of the complex exponential function, and so convergence acceleration methods have been introduced. We propose an inversion method that deforms the contour to follow the path of steepest descent. The effect is to dampen the oscillation in the integrand and as a result we dramatically improve the accuracy of numerical quadrature. We demonstrate that we cannot always exactly follow the path of steepest descent because the deformed contour may not be valid. However, by approximately following the path of steepest descent, making adjustments when required to avoid zeros and singularities, we can achieve probability estimates with higher precision than with the existing methods.
Commercial Viability: The methods we are developing will be useful in a variety of fields. For example, solutions to differential equations are often obtained by applying the Laplace transform and so transform inversion is required to obtain a solution in the original domain. The moment generating function and the Laplace transform are simply reflections of each other across the imaginary axis. Thus, our method will be effective in inverting Laplace transforms as well. We intend to incorporate our procedures into software that will assist researchers working in other fields who have a need to invert such transforms.

Micah Thornton (#156)
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Enhancing the Efficiency of Random Extractor Functions with High-Radix Interpretation

A parameterized random value extraction function for producing symbol strings based upon a user-specified radix value is defined. The presentation of the extractor function is accompanied with a theoretical discussion that describes how the radix value, and hence the symbol set cardinality, affects the entropy of an extracted symbol string. Experimental results are provided where extracted strings with respect to different radix values are analyzed for randomness quality. The empirical data is obtained by applying our parameterized extractor function to a weakly random source that provides a set of inter-packet delay spacings observed from a network interface card in a general purpose computer. Our results show how the quality of the extracted random strings varies for differing radix values. These results provide guidelines for choosing an appropriate radix value in an extractor function.

Commercial Viability: This methodology can be used to increase the extraction efficiency of modern RNG's. When properly implemented it will allow more random values to be computed with a higher rate of speed. There are many modern day applications for random numbers including data security, simulation studies, chance mechanisms in games, and much more. If the efficiency at which the values are produced increases, than machines and algorithms that take advantage of these values will also become more efficient.

Benjamin Williams (#157)
Advisor: Lynne Stokes
Statistical Science, Dedman College

Samples, Unite! Understanding the Consequences of Combining Probability and Non-Probability Samples when Linking Records is Difficult

In this poster, I investigate combining a large non-probability sample with a smaller probability sample when it is difficult to correctly link records from the two samples. To estimate the total number of units in the population I present a method that treats the non-probability sample as its own stratum. This method is compared to current techniques under various settings of sample parameters and confidence in the matching process. I also examine the effect that record linkage has on the variance of the estimators of population total. This work is then tested on a real world example: the estimation of total fish removed from the Gulf of Mexico by recreational anglers. NOAA is implementing a new technique for gathering fishing statistics in the Gulf of Mexico that involves captains voluntarily self-reporting catch statistics via electronic tablets alongside a random dockside intercept sample. In order to combine the two data sources it is necessary to combine a probability sample (dockside intercept) with a non-probability sample (self-reports). Accurately matching anglers who both self-report and appear in the dockside sample is challenging, resulting in a useful test case for this thesis research.
Chiyu Zhang (#158)  
Advisor: Xinlei Wang  
Statistical Science, Dedman College  

A Comparative Study of Statistical Inference about Between-Study Heterogeneity in Meta-Analysis of Rare Binary Events  

Meta-analysis has been widely used in medical research to evaluate intervention efficacy and safety. The variation of treatment effects, measured by the heterogeneity parameter, may exist and can greatly affect the inference results. Comparative studies have been done for estimation and confidence intervals. However, none of the them focuses on rare binary events. No comprehensive comparison for hypothesis testing methods was performed. Our goal is to examine the performance of these methods and make recommendations based on our simulation studies for rare binary events. We summarized 18 estimators and categorized them into three main groups including method of moments estimators, likelihood-based estimators and Bayes estimators. We also compared nine methods for testing no heterogeneity and nine methods for constructing confidence intervals. We find that there is no uniformly "best" estimator or inference method. However, consistently better methods do exist. For the purpose of estimation, we recommend the improved Paule-Mandel estimator with low bias and mean squared error. For the purpose of hypothesis testing, the Biggerstaff, Tweedie and Jackson methods perform the best in controlling Type I error rate meanwhile achieving high power. For the purpose of interval estimation, we recommend the Q-profile confidence interval based on the actual coverage probability.

Xiaojie Zhu (#159)  
Advisor: Tony Ng  
Statistical Science, Dedman College  

A Parametric Estimation for System Lifetime Data with Known Signature  

In this paper, we consider the estimation of model parameters based on system lifetime data with known system signature using the minimum density divergence estimation method. Different estimation procedures based on the minimum density divergence estimation method using are proposed. A Monte Carlo simulation study is used to evaluate the performance of those proposed procedures and compare with the maximum likelihood estimation method under different contaminated models. We have shown that the proposed estimation procedures are robust to contaminations and model misspecifications. A numerical example is presented to illustrate the methodology developed in this paper.

Theology  

Karen Sherlock (#160)  
Advisor: Ruben Habito  
Theology, Perkins School of Theology  

Utilizing Interfaith Resources for Sustainable Growth and Ecological Healing  

Climate change is a real and imminent danger to real estate, food and water resources and is driven by our overconsumption. Despite decades of erudite documentation, scientific models & empirical data support, along with
demonstrated climatic shifts accompanied by threats to island populations, wild life survival and food production, to say nothing of air and water quality, we still see little public outcry for sustainability and resource consciousness. This project shows that not only is there a commonality between almost all faith systems in acceptance of Divine instruction to care for Creation, there is recognition that plurality of interfaith traditions can most importantly be leveraged to work toward ecological solutions and resulting sustainable growth. The decision-making process employed at almost all levels of our government is one of conflict. Unfortunately, this process has also been used by other decision-makers such as The World Band, NGO’s and environmentalists. The proposed solution to the problem of adversarial decision-making to address environment problems involved taking the commonality that I saw among Christian Protestant and Catholic faiths to include all world religions and build a collaborative coalition-building process for better success. Charts showing interfaith consensus and adversarial vs collaborative decision-making will be included.

Commercial Viability: This project provides suggestions to gain consensus on how to address destructive and costly overconsumption in order to implement real solutions that will save real estate, water and food resources for sustainable growth. Without such efforts, the negative impacts we already see from climate change will be irreversible and immeasurably costly.

UG = Undergraduate Student