



UNIVERSITY *of* ST. THOMAS

BUSH FOUNDATION PROGRAM GRANT:
COLLABORATIVE INQUIRY

Inquiry at UST:
A Poster Session with the Results of
Faculty/Student Collaboration
at the University of St. Thomas

Abstracts

Vol. 11
May 6, 2008

Introduction

The abstracts published in this volume reflect the value we at the University of St. Thomas place on faculty/student collaboration.

Students who have recently done collaborative work with a faculty member present that work in these abstracts and at this poster session for purposes of dissemination and scrutiny by their peers, their professors, and the academic public.

The University of St. Thomas expresses its deep gratitude to the Bush Foundation, who funded this event through a three-year Program Grant. The grant seeks to increase the use of inquiry-based teaching methods, so that students experience the real work of the professions, working on real problems often taken from outside the university, in the ways they will be called upon to employ their disciplines after they leave the university.

A second theme of the Bush Program Grant is to increase faculty/student collaboration. We believe that one of the very best ways to teach is to have professors work with students collaboratively. Students see how work is really accomplished in their chosen professions, and professors have the chance to share their work as it is being created.

We hope this event and this volume gives visibility and credibility to the ideas represented in our Bush grant



Robert Werner, Ph.D.
Program Director 2005-2008



Vanča Schrunk, Ph.D.
Program Grant Coordinator

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May 2008

As president of the University of St. Thomas, I am both pleased and proud to welcome you to the eleventh poster session devoted to faculty/student collaboration projects developed as part of our grant from the Bush Foundation, *Focus on Inquiry: Faculty/Student Collaboration at the University of St. Thomas*.

I believe that one of the most effective ways for students to learn is through collaborative inquiry: students and faculty working together on research that can have real-world consequences. This is completely in keeping with our mission as a Catholic university grounded in the liberal arts tradition. We strive to provide a high degree of personal attention in a challenging campus environment that is engaged with the complexities of our urban community and the world beyond.

Collaborative inquiry gives our students the opportunity to experience first-hand how their professors approach research questions in a given discipline. It also gives our faculty a better opportunity to understand how our students think, and helps them develop new ways of looking at research problems. Collaborative inquiry enables our students and faculty to experience their disciplines in action, deepening students' academic experience while simultaneously increasing career competency.

I am very proud of what our students and faculty are doing and I hope the work represented here will illustrate the importance of collaborative inquiry at St. Thomas.

Sincerely,

A handwritten signature in cursive script that reads "Dennis Dease".

Reverend Dennis Dease
President

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Julia M. Anderson

THE RELATIONSHIP BETWEEN STRIDE LENGTH AND INJURY IN TRAINED COLLEGIATE RUNNERS

Faculty Collaborator: Dr. Bridget Duoos

PURPOSE: The purpose of this study was to determine if there was a relationship between running stride length and injuries in trained collegiate runners. Previous research has indicated that a shorter stride tends to allow runners to run with minimal injuries. Over striding has been associated with a higher injury rate (Leubbers, P. 2005).

METHODS: Seven collegiate runners (three male, four female, age 19.71 +/- 1.11, wt. 141.86 +/-20.99) ran at a self-selected pace and were videotaped for two full strides, with a Canon ZR850 Mini-DV video camera capturing the stride from the side. Runners completed surveys to document current and past leg injuries. Data on years running, miles per week, age, height, and weight was also collected. Videotape was digitized using Kinematics Analysis Video software (Schleihauf, 2004).

RESULTS: A negative high correlation between stride length and injury was found in the runners. A Pearson correlation test resulted in a -.607 coefficient, signifying that a shorter stride length was associated with increased injury rate.

CONCLUSIONS: There are many other factors to consider when a runner sustains a running injury, including anatomical structure, training, and other biomechanical factors. Runners using their own self-selected stride length may have other issues contributing to their injury rate. Most runners should be encouraged to run with a form that feels the most natural to them.

Jon Atbmann and Mary Hammer

IN PURSUIT OF LUMINESCENT RUTHENIUM COMPOUNDS

Faculty Collaborator: Dr. David Boyd

In an attempt to improve the efficiency of photovoltaic devices, a series of ruthenium bipyridine compounds have been prepared and characterized. The visible light absorbance of these ruthenium compounds can collect and deliver a larger portion of the energy available in the solar spectrum to a photovoltaic device if properly integrated into the device. The compounds studied include several that can be covalently linked to the metal oxide particles as part of the fabrication of the photovoltaic device. The synthesis and characterization of ligands and ruthenium compounds will be described.

Nathaniel C. Brandt

INVESTIGATION OF PYRRROMETHENE DYES IN THE PRESENCE OF QUINONES BY TRANSIENT ABSORPTION SPECTROSCOPY

Faculty Collaborator: Dr. Joseph M. Brom

Pyrrromethene (PM) dyes enjoy important applications in dye lasers and luminescent materials and are suspected to undergo a variety of photoinduced electron transfer processes due to their ability to undergo both oxidative and reductive processes from the excited state. For additional evidence of oxidative quenching mechanisms systems of PM dyes in the presence of electron accepting quinones were studied via transient absorption spectroscopy in order to characterize the radical ion products expected for these mechanisms. Spectroscopic investigations of PM567 dye in the presence of benzoquinone, naphthoquinone, anthraquinone, chloranil, and duroquinone yielded consistent spectroscopic evidence of the PM567 radical cation at 410nm as well as photobleaching of the PM567 ground state

above 470nm. Absorptions corresponding to quinone radical anions and possibly semiquinone radicals were also observed concomitantly with PM567 radical species.

Kyle Braun and Christian Lytle

A HYDROCOLLOID-BASED PHOTOELASTIC MODULATOR

Faculty Collaborator: Dr. Adam Green

Driven harmonically by a speaker coil, a block of birefringent gelatin acts as a variable retarder and can thus be used to sinusoidally vary the polarization of a laser beam. We model this effect with Mueller matrices and show that the system behaves much like a commercial photoelastic modulator. As such, it is well-suited for a variety of polarimetry experiments in an advanced undergraduate optics course.

Zoli Callaghan

THE AFFECT OF CORE STRENGTH ON SLAP SHOT SPEED IN ICE HOCKEY

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this study was to explore the relationship between core strength and slap shot speed in ice hockey. Determining this relationship can give us insight on how to help athletes achieve maximal levels of performance.

Six female collegiate ice hockey players (age=20.2 yr. \pm 2.1; ht=170.18 cm \pm 3.23; wt=68.85 kg \pm 10.48) volunteered to participate in this study. Maximum voluntary contractions (MVC) of the *rectus abdominis* and external obliques were recorded twice for each subject using the BIOPAC MP 35 surface electromyography (SEMG). Subjects performed maximal contractions of the two muscles while using a StairMaster Ab/Torso/Oblique weight machine. The second MVC was used for analysis purposes. During a third session, subjects performed five slap shots at a designated target from a distance of 40 feet while being videotaped from the side with a Canon ZR850 Mini DV video camera. The third and fourth shots were digitized using Kinematics Analysis Video (Schleihauf, 2004) to determine the average puck velocity.

Strong correlations were found between shot velocity and both external oblique and *rectus abdominis* strength. However, these were negative correlations suggesting that as core strength increased shot velocity decreased. Only the P-Value for *rectus abdominis* strength proved to be statistically significant with a P-Value of .05.

Vanthana Chounlamountry

SUBSTITUTION PATTERN AS A SELECTOR OF PACKING MOTIFS IN CRYSTAL STRUCTURES OF HALOGEN-NITRILE SUBSTITUTED BENZYLIDENEANILINES

Faculty Collaborator: Dr. William H. Ojala

We are investigating by means of single-crystal X-ray diffraction the solid-state structures of compounds we have designated “bridge-flipped isomers,” pairs of compounds in which the molecules differ only in the orientation of a bridge of atoms linking two major molecular fragments. We are currently examining the crystal structures of isomers from the benzylideneaniline family of organic compounds, where the bridge-flipped relationship is Ar-CH=N-Ar' vs. Ar-N=CH-Ar' where Ar = aryl. Co-crystallization of different isomers may yield solid materials possessing properties that could be “fine-tuned” by adjusting the relative proportions of the two isomers in the solid. Those isomers that assume the same molecular packing in their respective crystals—that is, those isomers that are *isostructural*—would be those most likely to co-crystallize readily, so we are conducting a systematic search for isostructural pairs. We have been examining benzylideneaniline isomers bearing both a nitrile group and a halogen atom to determine whether

similar Lewis acid-Lewis base contacts between the nitrile and the halogen occurring in both bridge-flipped isomers might encourage these isomers to form isostructural crystals. In previous work we determined the crystal structures of isomers in which the halogen atom is located on the *para* position of one ring and the nitrile group is located on the *para* position of the other ring (that is, *para, para'*); we have also examined the *ortho, para'* and *para, ortho'* patterns. Although we have yet to obtain any isostructural pairs among these compounds, we are interested in examining other substitution patterns. Our extensive efforts to obtain X-ray quality crystals of benzylideneanilines with a variety of new substitution patterns, after many unsuccessful attempts that yielded only microcrystalline samples, have now been successful in the case of the *para*-bromobenzylidene-*meta*-cyanoaniline, which has now been subjected to analysis by single-crystal X-ray diffraction.

Jordan Crow

POLYLACTIC ACID - POLY-L-SERINE BIODEGRADABLE COPOLYMERS WITH BIOCOMPATIBLE DELIVERY

Faculty Collaborator: Dr. J. Thomas Ippoliti

Polymers that break down into naturally occurring molecules in the body are of great interest for biomedical applications. We are interested in synthesizing a copolymer of polylactic acid (PLA) and polyserine, which breaks down into natural occurring byproducts, lactic acid and serine. While the properties of PLA are well known, the addition of polyserine provides a novel mechanism for functionalizing the biodegradable polymer. Serine has been successfully coupled with benzylchloroformate to protect the amine in good yields and the serine monomer has been lactonized.

Using benzyl alcohol and Tin(II) Octanoate at elevated temperatures, a copolymer was successfully synthesized. Additionally, serine has been successfully coupled with the trityl group to protect the amine in high yields and the protected serine has also been lactonized. Trityl protected serine however does not polymerize while using metal catalysts. New ways of polymerizing this monomer using carbenes are being investigated.

Selina Debn

IS THERE A DIFFERENCE IN THE HEART RATE OF SPRINTERS DURING A WORKOUT ON THE TRACK VERSUS A WORKOUT ON THE EXERCISE BIKE?

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this study was to determine whether a sprint workout done on the exercise bikes provides a cardiovascular workout similar to one done on the track.

Five college females (age – 19.6yr. \pm 1.5; ht – 167.5cm \pm 5.65; wt -162.29 \pm 5.64) all members of the St. Thomas woman's track team and engage in sprint workouts two to three times a week volunteered to be in this study. Heart rate was determined using a Polar Heart Rate monitor (model E600) which was set to measure heart rate at five second intervals. The first time heart rates were taken was during a 200 meter track workout. The workout consisted of running six 200 hundreds at 85% (roughly 30-32 seconds) with two minutes rest in between each 200. Heart rate monitors started recording at the beginning of the actual workout (after warm-up) and was stopped as soon as the subjects crossed the finish line of their last 200. The second time heart rates were recorded was during the exercise bike workout (Lifetime Fitness Exercise Bike). This workout consisted of each subject doing a bike version of the same workout; which was maintaining an RPM on the bike of 130-135 for 30 seconds (to simulate the 200's) then resting for 40 seconds (lowering the RPM to 50-60).

Significant differences between the heart rates on the bike and track where calculated using a paired t-test. Data is being analyzed.

Dan Desmond

SELECTIVE ANALYSIS OF HIGH-BOILING AROMATIC COMPOUNDS USING THE ARSLID

Faculty Collaborator: Dr. Tony Borgerding

The ArSLID, or Aromatic Selective Laser Ionization Detector, is a detector used in conjunction with a gas chromatograph to produce highly selective results, revealing only the aromatic compounds in a sample. This is done by the use of a laser and Resonance Enhanced Multi-Photon Ionization (REMPI). The laser excites all compounds within the sample, most of which shed the excess energy and settle back down to a lower energy state. Aromatic compounds, however, retain this energy through resonance for a sufficient amount of time to be excited again, raising the molecule's energy level. This repeats until the molecule is ionized. This ionization is then picked up by the detector and translated into a data collection program. In our research, we overcame earlier limitations, such as temperature stability and detection volumes. Previously, only compounds whose boiling points were below 150 °C could be measured; however, after removing all epoxides and cold spots, and replacing these with metal fasteners and more insulation, we are running the instrument at a stable 280 °C. As a result, we have been able to analyze compounds with boiling points as high as 495 °C, in the case of benzo[*a*]pyrene, and have shown our detector to have a much better aromatic selectivity for diesel than a simple photoionization detector (PID).

Lanita Marie Gaworski

SYNTHESIS OF LATENT CHROMOPHORES FOR COUPLING WITH ALCOHOL OXIDASE AS A NOVEL VISUAL INDICATOR SYSTEM FOR ELISA

Faculty Collaborator: Dr. J. Thomas Ippoliti

Alcohol oxidase (AOX) is an enzyme, which can be isolated from the yeast *Pichia pastoris*. AOX reacts with primary alcohols forming an aldehyde and hydrogen peroxide. AOX and its reaction with primary alcohols are used in a new enzyme-linked immunosorbent assay (ELISA). This ELISA gives a novel way to quantify antigen concentration in a sample using a latent chromophore as an indicator. The goal of this research is the synthesis of latent chromophores, which when coupled with AOX and a primary alcohol, react with the hydrogen peroxide byproduct to give a visual colorimetric indicator. Progress has been made towards the formation of borate ester based indicators for use within the novel ELISA. The intensity of the color change of the indicator is quantified in order to determine the amount of antigen within the sample.

Kevin Haglund

DETECTING CNS FATIGUE IN DIVISION III SPRINTERS AND JUMPERS

Faculty Collaborator: Dr. Bridget Duoos

Purpose: The purpose of this study was to determine if Central Nervous System (CNS) fatigue could be measured in Division III sprinters and jumpers by using the finger tap test. Finding a difference in the number of taps performed in the tap test and the degree of difficulty of workouts was to be established.

Methods: Fourteen Division III collegiate sprinters and jumpers (age: 20.4 yrs \pm 1.34; ht: 5.96 ft \pm .16; and wt: 173.8 lbs \pm 21.99) performed the tap test once each day before going to track practice. The athlete tap tested using the Lafayette Adult Finger Tapper (Model 32726), tapping for ten seconds as fast as they could using their index finger of their dominant hand. The previous day's workout was recorded. Athletes then provided a one-word descriptor of their perceived physical fatigue level.

Results: Matched paired t-tests show that there is a significant difference at the .05 level of significance between the number of taps athletes performed the day after an easy workout and the day after a hard workout (T-value = 3.05). No significant differences were shown between other post easy workout days (T-values < 1).

Conclusions: A significant difference between post easy day workout number of taps and post hard workout number of taps was found. This study does suggest that CNS fatigue may be relevant and measured by using the finger tap test. Further research is needed with a greater number of subjects and longer period of testing.

Mary Hammer

LC/MS/MS ANALYSIS OF PFCs

Faculty Collaborator: Dr. Tony Borgerding

Perfluorinated Compounds (PFCs) are used for stain repellent materials (e.g. scotch guard) and are frequently dumped into landfills. The PFCs are water-soluble and leach into the groundwater. These compounds are resistant to degradation and are present in the water supply. LC-MS/MS can be used to identify trace levels of PFCs found in various environmental samples. As a prelude to longer-term studies, we have optimized ionization and mass spectrometric conditions for specific PFCs. Specifically a negative ion polarity was set, Quadrant 1 (Q1) mass setting for the sulfonate and acid molecular weights were set (Acid-4C 213, 5C 263, 6C 313, 8C 413, Sulfonate- 4C 299, 6C 399, 8C 499), and Quadrant 2 (Q2) mass settings to the corresponding fragmented ion were set (Acid- 4C 169, 5C 219, 6C 269, 8C 369, Sulfonate-4C 98.6, 6C 98.6, 8C 98.6). The capillary was set to -70 for the acids and -35 for the sulfonates, the collision energy was set to 10 for the acids and 35 for the sulfonates, and the dwell time was set to 0.200. Using these optimized conditions, we can detect the fragmented acid and sulfonate ions at 10 ppb. Since the PFCs are found in very low concentrations we have also developed a solid-phase extraction method to concentrate the samples onto non-polar cartridges, followed by elution with methanol. Results from these studies show that a 5ml to 1ml extraction results in about 2-3 times more concentrated solution and a 10ml to 1ml extraction results in about a 4-5 times more concentrated solution.

Meg Henry

MUSCLE ACTIVITY DURING YOGA BREATHING EXERCISE COMPARED TO ABDOMINAL CRUNCHES PERFORMED ON AN INCLINED BOARD

Faculty Collaborator: Dr. Bridget Duoos

This study was designed to establish the maximal muscle exertion in the lower abdominal muscles, compare these measurements to those found during a yoga breath and a sit up performed on an inclined board, and determine which exercise provides the more efficient workout.

Nine adult female subjects (ages 21.33 ± 1.22 yrs., weight 125.56 ± 2.121 lbs.), were first asked to perform a maximal voluntary contraction for 15 seconds on an abdominal crunch machine. They then performed a five-second yoga breath and five sit-ups on an inclined board. Subject exertion of the lower rectus abdominis was measured using Biopac MP35 electromyography (EMG). Subjects were able to exert maximal voluntary contractions on the abdominal crunch machine of 1.335 ± 0.668 Hz, 0.354 ± 0.368 HZ during the yoga breath, and 1.165 ± 0.776 Hz during an inclined board sit-up.

Statistical significance was determined through a t-test. Subjects elicited 86.22 ± 15.00 % of their maximal voluntary contraction during an inclined board sit-up, and only 26.76 ± 16.79 % during the yoga breath exercise.

Lauren Hible

THE EFFECT OF FLAT DANCE SHOES VS. POINTE DANCE SHOES ON ARCH HEIGHT IN NOVICE PRE-TEEN FEMALE DANCERS VS. EXPERIENCED COLLEGIATE FEMALE DANCERS

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this research was to measure the effect that different dance shoes have on arch height in novice pre-teen (age = 12 ; years of dance experience = 7) and experienced collegiate female dancers (age = 18; years of dance experience = 14) and to determine if arch height is affected by years of dance experience. The results of this study give dancers a better idea which type of dance shoe is appropriate for their foot structure and help them determine if additional support is needed in their shoe. Dancers completed a survey that asked their age, shoe size, years of dance experience, length of time they have worn toe shoes (if applicable), types of injuries, and activity level. It was hypothesized that the type of dance shoe worn would affect arch height, and that the older and more experienced dancers would have an increased arch height than that of the younger, less experienced dancers. It was also hypothesized that dancers using toe shoes would have higher arch heights, and that increased years of experience dancing, the higher the arch height would be. Navicular drop was measured in weight bearing and non-weight bearing positions and the change in degrees was calculated. Arch height and angles were determined from a footprint made of each dancer's foot. A two-sample t-test and a correlation test will be used to determine if novice dancer arch heights are significantly different from experienced dancer arch heights.

Matthew Humbert

FAST EXTRACTION AND DIRECT DETECTION OF AQUEOUS NITRIC OXIDE USING GAS PHASE MICRODIALYSIS PROBES

Faculty Collaborator: Dr. Tony Borgerding

Gas phase microdialysis probes have been used to extract volatile compounds in solution. The probes used are small (200micron diameter) and can analyze both polar and non-polar compounds. The probes have been interfaced with a Sievers Nitric Oxide Analyzer to directly measure nitric oxide in aqueous solution for the first time. Aqueous nitric oxide has been measured with the probes at .005 mM levels. The probes have a very fast response time (<3 seconds) when monitoring nitric oxide concentrations. Increasing the amount of microdialysis membrane that is exposed to the solution has been shown to increase probe sensitivity to nitric oxide.

Dan Hutton

THE EFFECTS OF WEIGHT LOADING ON THE KINEMATICS OF THE SQUAT EXERCISE IN MODERATELY TRAINED MALE ATHLETES

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this study was to determine if there was a change in the kinematics of the squat exercise in moderately trained male individuals with additional loading. It was hypothesized that there would be a significant difference between the kinematics of the squat exercise with increased loading.

Ten moderately trained male individuals (age= 20.1 ± 1.2 yr; ht=71.3±1.7in; wt=176.2±16.1lbs) performed two sets of three repetitions of the squat exercise. The first set was performed with a weight equal to 45% of the given subject's one rep max (the maximum weight lifted in one repetition, 1RM) and the second set was performed at a weight equal to 85% of the individual's 1RM. The movement was videotaped from the sagittal plane at a height of

1.1m and a distance of 3.5m. The video was digitized using Kinematic Analysis Video Software (Schleihauf, 2004). The following joints were analyzed: neck, right and left shoulder, right and left elbow, right and left hip, right and left knee, right and left ankle. The right knee angle was analyzed using Minitab 15 Statistics Software (2006). A t-test was used to determine the significance of the results. The test showed that the results were not significant ($df=17$, $t=-0.90$, $p=0.381$).

Sarah E. Just

THE RELATIONSHIP OF HIP MUSCLE IMBALANCE TO CORE STRENGTH AND STABILITY

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this project was to determine the relationship between right and left hip muscle imbalances on core strength and stability.

Twelve female collegiate students (age 19.8 yrs \pm 1.3; ht 64 in \pm .9; wt 140 lb \pm 11.3) performed three core balancing tasks on the Lafayette Instrument Company Stability Platform (Model 16030). Subjects performed a quadrupled arm raise with the body parallel to the tilt axis and alternated raising their left and right arms according to a metronome set at 40 beats per min for 30 seconds. Subjects then performed a quadrupled arm raise with the body perpendicular to the tilt axis and alternated raising their left and right arms according to a metronome set at 40 beats per min for 30 seconds. The final core task was a kneeling test; subjects alternated their arms at 60 beats per min. Hip extensor and abductor strengths were measured using the Lafayette Manual Muscle Tester (Model 01163). Hip extensor strength was measured 1-1.5 inches above the middle of the thigh while the knee was flexed. The hip abductor was measured on the lateral thigh, 4 inches above the distal end of the thigh. Fifteen seconds of rest was provided between each trial. This measurement had three trials, maximum and the average measurements were used.

Extremely poor correlations (0.066, 0.022, 0.030) were found between changes in hip extensor and hip abductor strengths compared to the three core balancing tasks. Subjects that demonstrated a small change in hip extensor and abductor strengths scores were more likely to score poorly on the three core strength and stability balancing tasks. Subjects that demonstrated a large change in hip extensor and abductor strength were more likely to have consistent scores in core strength and stability balancing tasks.

James Kavanaugh

STOCK SHEETS OF POLYCARBONATE AS INEXPENSIVE LOW-ORDER OPTICAL WAVEPLATES

Faculty Collaborator: Dr. Adam Green

The optical properties, specifically the linear retardance magnitude, of two thicknesses of McMaster-Carr polycarbonate were characterized using a Xenon light source and an Axometrics Polarimeter. Retardance values were measured for multiple wavelengths and polycarbonate orientations in order to determine the effectiveness for the poly-carbonate to be used as a cheap alternative for expensive zero order quarter- or half- wave plates. Results indicate that the 0.118 inch and 0.0625 inch thicknesses of the poly carbonate have all of the characteristics of a low (zeroth and first) order retarder. Further results show that quarter and half wave plate characteristics are achieved across the visible spectrum by rotation around the fast or slow axis of 40 degrees or less.

LOWER EXTREMITY IMBALANCES IN COLLIGATE DANCERS

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this study was to determine whether there is a significant difference in the muscular strength of collegiate dancers.

Ten female collegiate dancers (age = 20.2 ± 1.32 yr; ht = 65.15 ± 1.49 in; wt. = 121.7 ± 9.99 lbs) all members of the 2007-2008 University of St. Thomas Dance Team volunteered to participate in this study. The participants filled out a questionnaire to document injuries sustained. Severity of pain was rated on a scale. Right and left quadriceps and hamstring strength were tested with the Lafayette Manual Muscle Tester (Model 01163). Medial and lateral rotator, abductor, and adductor strength was also measured using the Lafayette Manual Muscle Tester. Each site was tested three times with fifteen seconds of rest between measurements. The average value of measurements was used for analysis.

Data was analyzed using a paired t-test. Strong correlations were found between the right and left hamstring muscles (0.52), right and left abductor (0.86) and right and left adductor (0.89) muscle groups.

Significant strength differences between the right and left sides of collegiate dancers were found in the right and left quadriceps (0.02), right and left medial rotators (0.05), and lateral rotators (0.03). These results may indicate that certain repetitive movements that dancers perform cause muscular imbalance.

THE EFFECT OF HYPERPRONATION OF THE FEET ON PELVIC ALIGNMENT IN A STANDING POSITION

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this research project was to study the effects of foot hyperpronation on the pelvic alignment in a standing position. Hyperpronation is excessive inward rotation of the ankle joint and foot during walking or while standing and has been suggested to be the cause of improper alignment of the lower extremities (Ireland et al, 2003). This improper alignment could then lead to structural and functional problems in walking and standing and could also increase one's susceptibility to injuries of the lower extremities (Kaufman et al., 1999). How greatly does hyperpronation of the feet affect the alignment of the hips? To determine how improper alignment of the feet affects the alignment of the hips, eight female subjects stood in the following four different standing positions: flat feet on the floor, on a wedge angled at ten degrees, on a wedge angled at fifteen degrees, and on a wedge angled at twenty degrees. Markers were placed on the subject's iliac crest and pictures of subjects were taken from the front to measure the displacement of the iliac crest from the control position, flat feet. Dartfish was used to measure the hip angles. Increased degrees (15 and 20 degrees) of foot hyperpronation had the greatest effect on the pelvic alignment (mean pelvic movement at 15 degrees was $3 \pm .93$ degrees, at 20 degrees mean pelvic movement was $3 \pm .93$ degrees). These results support the kinetic chain theory which states that the extremities all work as a system of sequential links.

IDENTIFYING FACTORS RELATED TO RETENTION AT CATHOLIC COLLEGES AND UNIVERSITIES

Staff Collaborator: Dr. Michael Cogan

In recent years, the issue of fall-to-fall retention has gained momentum through high profile publications such as Margaret Spellings Report. Fall-to-fall retention occurs when a first-time, first year freshman student completes one year of college and subsequently returns to the same college the following year. Nationally, 71 percent of freshman students entering U.S. higher education institutions in the fall of 2006 returned to the same institution the following fall (fall-to-fall retention).

There have been many research studies regarding fall-to-fall retention; however, few relate directly to Catholic colleges and universities. The purpose of this study was to determine whether certain characteristics of U.S. Catholic institutions could be used to predict fall-to-fall retention of incoming freshman students. The study utilized a multiple linear regression technique employing forward stepwise entry to determine factors significantly related to fall-to-fall retention.

The data utilized in the study was extracted from the National Catholic College Administration Association and the National Center for Education Statistics.

We narrowed the list to 157 schools with complete information. This includes factors such as tuition, enrollment statistics, student to faculty ratio, and financial aid. The results show a significant relationship between three factors and fall-to-fall retention of freshman.

Brianna C. MacQueen

CRYSTAL AND MOLECULAR STRUCTURE OF AN UNANTICIPATED DIAMINE BYPRODUCT OF A SCHIFF BASE SYNTHESIS

Faculty Collaborator: Dr. William H. Ojala

We have been investigating the solid-state structures of pairs of isomeric benzylideneanilines differing only in the orientation of the bridge atoms (Ar-CH=N-Ar' vs. Ar-N=CH-Ar') to identify pairs that assume similar molecular packing arrangements in the crystal. Such *isostructural* “bridge-flipped” isomers might be suitable for the formation of solid solutions of the two isomers; the properties of the solids thus formed might be “tailorable” by the inclusion of systematically varied amounts of the two isomers in the solid. We have focused on pairs of benzylideneanilines in which both isomers bear one halogen atom and one nitrile group to determine whether Lewis acid-base contacts in the solid state of the form $\text{---X-R-C}^\circ\text{N:---X-R-C}^\circ\text{N:---}$ might link molecules into chains in both isomers, with the formation of similar chains favoring isostructuralism. Of the halogens, iodine is the most likely to act as a Lewis acid in these interactions. In an attempt to prepare *N*-(2-iodobenzylidene)-4-cyanoaniline by the condensation of 2-iodobenzaldehyde with 4-cyanoaniline, we obtained a crystalline product and determined its structure by single-crystal X-ray diffraction. In contrast to all of our previous benzylideneaniline syntheses, this reaction yielded a product in which *two* substituted anilines reacted with one substituted benzaldehyde. The molecule, $\text{I-C}_6\text{H}_4\text{-CH-(NH-C}_6\text{H}_4\text{-C}^\circ\text{N)}_2$, is propeller-shaped, and its packing arrangement involves not nitrile—halogen contacts but nitrile— -H-N contacts. A search of the Cambridge Structural Database reveals only seven previous examples of this kind of di-addition product, all involving a limited range of primarily electron-deficient aldehydes (chloral, formaldehyde, or isomeric pyridines).

Kyle Marchuk

THE DEVELOPMENT OF HIGH PRECISION, HIGH ACCURACY METHODS OF CHEMICAL ANALYSIS APPLIED TO EXTREMELY TINY VOLUMES

Faculty Collaborator: Dr. Gary Mabbott

We have built a fluorescence microscope with the capability of scanning emission spectra for all objects in the field of view simultaneously. Our interest is in quantifying chemicals, such as drugs, in tiny volumes, such as sub-cellular compartments of a biological cell. These types of samples represent a mixture of micro-environments and present challenges for analysis. Many fluorescent compounds exhibit changes in their spectral profile and their quantum yields depending on the conditions of their surroundings. Spectral images may help circumvent some of the limitations for quantitative analysis of these types of samples by conventional fluorescent microscopy.

Kristine Maurer

INFLUENCES OF MACROPHYTES AND FISH ON AQUATIC INVERTEBRATE POPULATIONS IN MINNESOTA SHALLOW LAKES

Faculty Collaborator: Dr. Kyle Zimmer

Research has shown positive relationships between abundance of submerged macrophytes and aquatic invertebrates in shallow lakes. However, few studies have assessed whether these influences depend on fish community composition, or vary among geographic areas. We sampled 70 lakes in two areas of Minnesota (Polk and Grant counties), and tested for relationships between abundance of macrophytes and several groups of invertebrates. We also assessed whether relationships differed between planktivore-only lakes (P) versus lakes with planktivores and benthivores (P+B). In P lakes, significant trends were limited to negative relationships between macrophytes and copepods and large cladocerans, but only in Grant County. In contrast, macrophytes in P+B lakes showed positive relationships with insects and snails, negative relationships with most zooplankton, while no relationships were detected in Polk County. Our results show that macrophytes may have significant effects on invertebrate abundance, but relationships vary according to taxonomic groups of fish, invertebrates, and geographic areas.

Madelyn E. Mayry

DIETARY PREFERENCES IN THE SNAIL, *POTAMOPYRGUS ANTIPODARUM*: IMPLICATIONS FOR THE MAINTENANCE OF SEXUAL REPRODUCTION

Faculty Collaborator: Dr. Adam D. Kay

One of the major unsolved problems in evolutionary biology is why, given the predicted two-fold cost of sex, the vast majority of species are sexual. The purpose of our research is to identify phenotypic differences between sexuals and asexuals that might help to explain the predominance of sex. Previously, our research team has found that asexual lineages of a New Zealand snail (*Potamopyrgus antipodarum*) contain significantly higher amounts of phosphorus (P) compared to sexual lineages. However we found wide variation in bodily P content amongst asexual lineages such that several asexual lineages had very low P content, comparable to the P content in sexual lineages. Phosphorus is a nutrient that is often limiting within natural populations, and the implications are that most asexual *P. antipodarum* might have higher dietary requirements for P than their sexual counterparts.

There is a variety of evidence from other snail species that individuals preferentially consume food that is well-matched to their dietary requirements. The goal of our study was to examine whether dietary preferences in *P. antipodarum* are associated with P content, and perhaps, sexuality. We compared the dietary preference for 0.2% (low) vs. 2% (high) phosphorus diets between asexual *P. antipodarum* lineages of varying P content. Our main prediction is

that asexual lineages with high bodily P content will have a stronger preference for high P food. The research we did is important because broader dietary preferences in low-PP. *antipodarum* lineages could point to a potential advantage for sexual *P. antipodarum* in environments where P availability is low.

Kathryn McGarry

THE SYNTHESIS OF A NOVEL ANTIMICROBIAL AGENT

Faculty Collaborator: Dr. J. Thomas Ippoliti

In recent years, multi-drug resistant strains of bacteria have been causing problems for human health. Oxazolidinones, a synthetic class of antibiotics, have proven to successfully combat resistant bacteria. The focus of my research is the synthesis of an oxazolidinone antibiotic functionalized with a thiadiazole group. Originally, a six-step synthesis was laid out for this compound. The focus of my research this past semester was to develop new synthetic methods to shorten the synthesis. The full synthesis will be presented, as well as the new synthetic methodology pursued to convert an azide and an alcohol to an amine.

Katherine M. Motz

SELF-ASSEMBLY AND STABILIZATION OF G-WIRES USING ALKYL AMMONIUM CATIONS

Faculty Collaborator: Dr. Thomas C. Marsh

G-wires are linear G-DNA supramolecular polymers that self-assemble from guanine-rich nucleic acid oligomers. The fundamental structural element of a G-wire is the G-quartet, a cyclic structure of four guanines held together by hydrogen bonds. Previous research has shown that monovalent cations, such as potassium (K^+), sodium (Na^+), and ammonium (NH_4^+) serve to stabilize G-DNA structures by coordinating between stacked G-quartets. This research explored the potential of using alkyl ammonium cations to stabilize G-wires. The molecular cations used in this study included ethanolammonium ($EtOHNH_3^+$), dimethylammonium (DMA), trimethylammonium (TMA), choline, lysine, and spermidine. Results from Polyacrylamide gel electrophoresis (PAGE) assays, UV thermal denaturation and TM-AFM showed that primary alkyl ammonium cations, such as $EtOHNH_3^+$, facilitate G-wire formation and stability. The ability of an alkyl ammonium cation to stabilize G-wires significantly decreased as the number of alkyl groups bound to the nitrogen. These results show promise for developing new ways of organizing alkyl ammonium passivated nanoparticles by targeting the coordination site of G-DNA.

Bethany Rhein

THE EFFECT OF DIFFERING PHOTOPERIODS ON THE OUTPUT GENES, PSBA1 AND PURF OF THE CYANOBACTERIUM SYNECHOCOCCUS ELONGATUS

Faculty Collaborator: Dr. Jayna L. Ditty

Cyanobacteria are single-celled prokaryotes that exist and thrive in most habitats on earth and use a circadian clock to efficiently regulate their cellular activity. The oscillator genes *kaiA*, *kaiB*, and *kaiC* are responsible for the circadian mechanism and therefore regulate output gene activity. Genes such as *psbA1* (important for photosynthesis) and *purF* (important for purine biosynthesis) are examples of two output genes that are expressed in the cyanobacterium *Synechococcus elongatus* PCC 7942 due to the circadian clock.

Photoperiods have been shown to have considerable impacts on circadian clocks in other model systems; however, the effect of photoperiod on the cyanobacterium *Synechococcus elongatus* is not well understood. To determine the

effects of photoperiod on cellular activities, *S. elongatus* reporter strains AMC408 (*purF::luxAB*), AMC669 (*psbA1::luxAB*) and the wild-type AMC462 were exposed to 12L:12D (12-hours of light and 12 hours of dark), 6L:18D & 18L:6D photoperiods. The wild-type *S. elongatus* results showed a 4-hour phase delay during the 18L: 6D photoperiod and a 4-hour phase advance in the 6L:18D photoperiod when compared to the 12L:12D phenotype. Preliminary results suggest that the AMC408 strain showed little difference in circadian oscillation in response to the different photoperiods, while AMC669 demonstrated a phase advance when exposed to either an 18L:6D or 6L:18D photoperiod compared to 12L:12D. These preliminary results suggest that the different photoperiods differentially effect the circadian expression of the wild-type *S. elongatus* and the different *S. elongatus* output genes, *purF* and *psbA1*.

Stacie Rominski

ASMAT CULTURAL REGIONS

Faculty Collaborator: Dr. Catherine Hansen

As a GIS Lab Assistant I was approached by Dr. Julia Risser, the Director of the Museum of Asmat Art at the University of St. Thomas, to create a regional map of the Asmat Region in Papua, Indonesia. The goal of the project was to digitize and recreate the Asmat Cultural Regions using GIS. A map in poster format, as well as a smaller map, to be used in the University of St. Thomas Museum of Asmat Art brochure, had to be created. The end results were two digitized maps of the different Asmat Cultural regions.

Greg Schieber

ATRAZINE AND NITRATE LEVELS IN PRIVATE WELLS IN SOUTHEASTERN MINNESOTA KARST COUNTRY

Faculty Collaborator: Dr. Kevin Theissen

Atrazine, a commonly applied corn herbicide, is a cause of rising concern due to discoveries of the effects of atrazine exposure to human health and the environment and its regular detection in the environment. Atrazine is a known carcinogen and low levels of exposure cause hermaphroditism and deformities in frogs. Similarly, nitrates from fertilizers present risks to human health. Heavy use of nitrates to fertilize crops and lawns results in nitrate pollution of surface and groundwater statewide. In 2005 atrazine was used on 24% of corn acres surveyed by the MN Department of Agriculture. Southeastern, MN typically receives the highest percentage of atrazine application of any part of the state. Southeastern MN is also characterized by a fractured landscape of karst topography including sinkholes, caves, and springs. Karst topography provides surface contaminants direct conduits to local groundwater. This study took a look at water samples from 38 private wells of varying depths in Houston County, located in Southeastern Minnesota's karst region. Samples from each well were collected and analyzed for atrazine and nitrate concentrations before and after spring snowmelt providing a temporal comparison. Preliminary results show atrazine and nitrates are both detectable in varying concentrations throughout the study area. As expected, shallow wells demonstrated higher levels of contamination, however, temporal changes were not as clearly defined. These results have important implications for human health and urgent relevance given the increasing demand for farm commodities like corn in liquid fuel production.

Kelsey Schultz

AN ANGIOBLASTIC MECHANISM FOR HEPATIC VASCULOGENESIS?

Faculty Collaborator: Dr. Glenn Sherer

Vasculogenesis, or blood vessel formation, of embryonic organs occurs by two mechanisms: angiogenic vasculogenesis involves the migration of differentiated vascular endothelial cells from pre-existing vessels; angioblastic vasculogenesis instead provides vascular endothelium by the differentiation of endothelial cell progenitors derived from organ-specific mesenchyme (Sherer, 1991). The distribution of these mechanisms is determined by their anatomic origin: organs derived from somatopleure (muscle and skin) vascularize angiogenically while those of splanchnic origin (most visceral organs) vascularize angioblastically (Pardanaud et al., 1989). However, the mechanism underlying the formation of the liver's sinusoids remains unclear. Evidence has been published which favors both their (angiogenic) sprouting from the ductus venosus and other vessels (Kingsbury et al., 1956) and their (angioblastic) differentiation from the liver's own mesenchyme (Sherer et al., 1983, 1984). We have reinvestigated this question by assessing the organization and distribution of vascular endothelial cells in the hepatic region and their proximity to larger adjacent vessels from which they might sprout. Quail (*Coturnix coturnix japonica*) embryos at Hamburger-Hamilton stage 14 were fixed in glyoxal, processed into paraffin, sectioned at 5 microns, and stained with endothelium-specific QH-1 monoclonal antibody and an Alexa-Fluor 488-conjugated secondary antibody, and coverslipped with a DAPI-containing mounting medium. Photographs were taken with a SPOT Insight camera mounted on a Nikon Microphot-FXA microscope and pseudocolored using SPOT Advanced software, after which slides were stained with H&E and photographed in brightfield. These photographs are being examined for the presence of stained cells in locations remote from established vessels, evidence that we would interpret as confirmation of angioblastic vasculogenesis.

Allison Seiwert

MAPPING 18TH CENTURY EUROPE

Faculty Collaborator: Dr. Catherine Hansen

After being recommended to Dr. Pat Howe of the UST History Department for my GIS services, I began working on a couple of maps for a history book she was writing called, *Foreign Policy and the French Revolution*. Because the maps she wanted were of the 18th century, a lot went into making the maps. Since there is no data of that time period, I had to digitize (draw in) all the features on the maps, but to do that I needed to research existing maps of that time period. Digitizing is the process of converting the geographic features on an analog map into digital format. It was a long process, but the final two maps, one of European Empires in 1789 – 1793 and the other of the Austrian Netherlands in 1789 – 1793, will be published in her book.

Louis Sigtermans

RESISTANCE IN ENVIRONMENTAL BACTERIA IN RESPONSE TO LOW-LEVEL EXPOSURE TO AN ANTIBACTERIAL AGENT

Faculty Collaborator: Dr. Kris Wammer

Resistance to antibiotics in pathogenic bacteria is a growing concern worldwide. Because of the possibility of resistance genes transferring between bacterial species, the rise of resistance in environmental bacteria is of interest. This project attempts to determine the effect of exposure to low levels of triclosan (a widely used antibacterial agent that is included in many consumer and personal health-care products) on the development of resistance in environmental bacteria. Bacteria collected from a natural water source were grown in bioreactors known as

chemostats. The bacterial populations in the chemostats exposed to triclosan were monitored over time and compared to populations grown in identical nutrient media but with no triclosan present. Resistance was monitored by growing samples of bacteria from the chemostats in media containing lethal levels of triclosan. If a population that has been exposed to low levels of triclosan is seen to grow more readily, it is likely that resistant organisms have been selected for. We have preliminarily observed higher growth in bacteria grown at 1 M triclosan concentrations. Future studies include analysis of community gene shifts to correlate observed growth differences with changes in community structure.

Tyler J. Smith

EFFECTS ON SOLID-STATE MOLECULAR PACKING OF SUBSTITUENT POSITION REVERSAL AMONG “BRIDGE-FLIPPED” ISOMERIC BENZYLIDENEANILINES

Faculty Collaborator: Dr. William H. Ojala

We are conducting a solid-state examination of organic compounds we have designated “bridge-flipped isomers,” in which the isomeric molecules differ from each other only in the orientation of a bridge of atoms that connects two major portions of the molecule. Pairs of these isomers that are *isostructural*, assuming the same molecular packing arrangement in the solid state, might be readily co-crystallized to form new materials with useful properties, so we are examining these isomers by single-crystal X-ray diffraction in order to identify isostructural pairs. We have been focusing on the benzylideneanilines, in which the bridge-flipped isomerism is Ar-CH=N-Ar' vs. Ar-N=CH-Ar' where Ar = aryl. We previously determined the crystal structures of a series of bridge-flipped benzylideneanilines that were substituted on the *ortho* position of one ring with a nitrile group and on the *para* position of the other ring with a halogen atom; this was to determine whether halogen-nitrile contacts of the Lewis acid-Lewis base type occurring in both isomers would encourage their isostructuralism. Although isostructuralism was not observed in that series, we are now investigating bridge-flipped benzylideneanilines in which the substituent positions have been reversed, the *ortho* position of one ring now bearing the halogen atom and the *para* position of the other ring now bearing the nitrile group. Here we describe the crystal structures of 4-cyanobenzylidene-2-fluoroaniline and 4-cyanobenzylidene-2-chloroaniline. These have proved to be unique structures, not isostructural with their 4-halobenzylidene-2-cyanoaniline counterparts or with each other. No close halogen-nitrile contacts are observed in either structure. Significantly with respect to isostructuralism with its bridge-flipped isomer (which has yet to be prepared), the packing arrangement of the fluoro compound involves a contact between the nitrile group and the bridge hydrogen atom, which is likely to differentiate this structure from that of the isomeric compound.

Jake Soderberg

RISK MEDIATES THE EFFECT OF MOOD ON EXTERNAL SEARCH

Faculty Collaborator: Dr. James Heyman

Previous research has shown that the amount of external search conducted by consumers differs between low and high involvement goods. In turn, the involvement level has been shown to be a function of the price and perceived risk of the product. Moods have also been shown to affect search patterns; sad people search less while happy people search more. This paper links together these three concepts: mood, perceived risk, and search with the goal of assessing the extent to which perceived risk mediates the effect of mood on search. Participants' moods were manipulated with video clips and a survey captured their mood and risk profile. We then tested their search involvement on a low involvement product and a high involvement one.

Joshua C. Speros

SYNTHESIS AND CHARACTERIZATION OF A NOVEL POLYMERIZABLE CHEMILUMINESCENT COMPOUND

Faculty Collaborator: Dr. J. Thomas Ippoliti

The synthetic route and methodology toward a new 3-aminophthalhydrazide (luminol) derivative is reported. 4-nitrophthalic acid was converted to a dimethyl ester before reducing the nitro moiety to an amine. A double S_N2 microwave reaction was performed in an aqueous environment to yield a new heterocyclic compound, which was then converted to the novel luminol derivative via microwave irradiation in the presence of hydrazine. Preliminary characterization shows promise for a new, cost-effective luminol product that is highly chemiluminescent. It is also shown that this synthesis requires no chromatographic techniques or tedious workup. Finally, the product shows promise for polymerization, which would lead to higher sensitivity among measurements and lower detection limits in various biological assays.

Katherine Theisen

TESTING THE GROWTH RATE HYPOTHESIS IN *POTAMOPYRGUS ANTIPODARUM*, A NEW ZEALAND FRESHWATER SNAIL

Faculty Collaborator: Dr. Adam Kay

Sexual reproduction reduces an individual's genetic contribution to offspring by half. Given this intrinsic cost, the predominance of sex in nature remains a mystery. Insights into why sex is so common can come from identification of phenotypic differences between sexual and asexual individuals. I am part of a research team that has shown that sexual and asexual lineages of *Potamopyrgus antipodarum*, a New Zealand snail, differ in body composition. Specifically, asexual *P. antipodarum* have significantly higher bodily phosphorus (P) and RNA content than their sexual counterparts. However, we also found considerable variation in P content among asexual lineages, suggesting a more complex explanation for P-content variation than sexuality alone. These differences in body composition are interesting because P is a) often scarce in natural environments, and b) a key component of RNA, which itself is positively associated with rapid growth. It follows that organisms with higher P and RNA content might grow more rapidly, but may also be more limited by P-scarcity in the environment.

One potential adaptive explanation for variation in bodily P and RNA content is provided by the growth rate hypothesis. This hypothesis makes predictions for the relationship between P content, RNA, and growth rate as a function of either 1) natural selection for rapid growth or 2) pressure from limited environmental resources. In this study, I am testing the first part of this hypothesis by examining whether snail lineages with higher P-content experience higher rates of growth when dietary P is not limiting. I am currently rearing juvenile snails from lineages known to vary in P content under similar conditions with plentiful high-quality food. Differences in growth rate between the lineages will be determined as changes in snail biomass over time. Determining whether individuals with higher P content do experience higher rates of growth could lead to further research into the sensitivity of both sexual and asexual snails to diet stressed and diet supplemented conditions. Differences in the ability of low- vs. high-P genotypes to respond to differing environmental conditions could help explain why sex persists in some environments.

BIOMECHANICS OF ADVANCED SNOWBOARDERS DURING TOESIDE TURNS

Faculty Collaborator: Dr. Bridget Duoos

Purpose: The purpose of this study was to determine the kinematics of an advanced snowboard rider performing a toeside turn.

Methods: Five advanced adult riders were video taped performing toeside and heelside turns on a light blue rated slope (relatively easy slope). Three male riders and two female riders (age = 24 ± 5.8 years) participated in this study. All riders were regular stance (left foot forward). Joints on each rider were marked prior to video taping. A Canon ZR-850 Mini DV video camera was used to video tape the snowboarders performance in the saggital plane. A calibration pole was filmed on each run for scaling purposes. Subjects were video taped taking two runs. For this study the toeside turn was analyzed using Kinematic Analysis 2D software (Schleihauf, 2004) to obtain joint angles during first and second edge changes. Joints digitized included both left and right: hip, knee, ankle, shoulder and elbow.

Results: Means and standard deviations were calculated for all joint angles. Measured joint angles were very consistent among all riders, among both corresponding left and right joints, and also between first and second edge changes. Joint angles (measured in degrees) had the lowest standard deviations in the lower body.

During the first edge change the lower body mean joint angles were: right hip $161.86^\circ \pm 11.42^\circ$, left hip $170.89^\circ \pm 13.18^\circ$, right knee $162.25^\circ \pm 8.43^\circ$, left knee $164.48^\circ \pm 8.45^\circ$, right ankle $81.12^\circ \pm 8.20^\circ$, left ankle $77.86^\circ \pm 9.17^\circ$. In the upper body the mean joint angles during the first edge change were: left shoulder $161.24^\circ \pm 18.25^\circ$, right elbow $153.96^\circ \pm 29.39^\circ$, and left elbow $161.56^\circ \pm 13.60^\circ$.

During the second edge change the lower body mean joint angles were: right hip $171.83^\circ \pm 13.18^\circ$, left hip $171.46^\circ \pm 6.95^\circ$, right knee $166.81^\circ \pm 11.63^\circ$, left knee $155.90^\circ \pm 8.39^\circ$, right ankle $76.61^\circ \pm 7.88^\circ$, left ankle $79.71^\circ \pm 7.38^\circ$. In the upper body the mean joint angles during the first edge change were: left shoulder $16.23^\circ \pm 20.77^\circ$, right elbow $155.74^\circ \pm 17.97^\circ$, and left elbow $145.53^\circ \pm 20.37^\circ$.

The right shoulder was omitted because the right arm was blocked by the rider's body throughout the movement.

Microsoft Excel was used to find the mean joint angles and their standard deviations. This study provides a kinematic description of advanced level snowboard riders performing toeside turns on a relatively easy run.

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