2011 Highlights of Undergraduate Research

Summaries of selected research projects presented at the 16th annual Denman Undergraduate Research Forum
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Highlights of Undergraduate Research at Ohio State

This publication celebrates research by the many undergraduate students at Ohio State involved in research and creative activities outside their normal course work. Whether students work independently or with faculty, graduate students, and peers, these talented and highly motivated students serve as inspirations to the entire university community. Each year, students are invited to present completed projects or works in progress at the Denman Undergraduate Research Forum.

In 2011, in the 16th year of the Denman Forum, 580 students participated in 529 projects. Some of these projects are quite technical because they are carried out in specialized fields of study. To make the projects more accessible to a general audience, we collected the following non-technical summaries from representative students. We invite you to browse these pages to learn about the excitement, value, and diversity of students’ accomplishments. This is only a brief introduction to the types of research projects our students are working on: a list of all student projects from this event, along with complete abstracts, is available at the Denman Forum website, denman.osu.edu. You also can find undergraduate honors theses at Ohio State’s Knowledge Bank, kb.osu.edu.

We thank the generous support of Richard and Martha Denman and the hard work of the Honors & Scholars Center at Ohio State for supporting the forum. We also thank corporate forum sponsors Eli Lilly & Company, Honda R&D Americas, Inc., Eaton, and Battelle; the individual supporters who make this forum a success, especially Dr. and Mrs. Gerard Rossala Boutin; and the many students, faculty, and staff who contribute to undergraduate research activities at the university. We are grateful to Ohio State alumna Lindsey Thaler, who created the image of the lantern on the back cover; and to the URO’s program coordinator Mike Bierschenk who worked extensively on this publication.

Professor Anne E. Carey
Interim Director

Ayla Cash
Student Advisory Committee Co-Chair

Kunal Parikh
Student Advisory Committee Co-Chair
Child predators on the Internet are an ongoing problem. Though there have been efforts to limit their activity, humans can only devote limited time to these efforts. By developing a conversational agent, or “chatbot,” that could constantly work to identify predators through chatting with them, child abuse due to online interactions could drop significantly. To solve this problem, I designed a chatbot with an internal emotional state that affects its interaction, making it appear more human-like. The agent also learns through a process called supervised learning: it reviews transcripts of actual chat dialogues. By processing the chat scripts and observing personalities and moods, the chatbot learns how to hold a conversation, change emotions, and make an educated guess of the emotional state of the person it is talking to. Supervised learning also allows the chatbot to form multiple personalities and shift moods, which prevents predators from catching on. Though my chatbot is not yet complete, the prototype shows promise by being able to quickly form new personalities and give emotionally consistent outputs. This research is applicable to many other scenarios because of the agent’s malleability. Future work will, I hope, make the robot form a personal background and consistent opinions.

Project Title: **Applying Supervised Learning and Emotional State to Conversation Agents**

Advisors: Paolo Bucci and Bruce Weide

**What’s next?** Forest will finish his senior year of college this coming year and plans to attend graduate school the following year.

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**Saving the Music Industry**

**Patrick Bond, '11** (Marketing)

Music piracy has cut away at the music industry for over a decade (since the advent of Napster), and though there have been many studies on piracy itself, no one had taken steps to research what could convince music consumers to buy instead of pirate. My project did just that: I set out to find a more enticing alternative to piracy for music consumers by conducting three studies involving over 600 participants ages 18–24. I first conducted a pre-test to learn more about music consumption habits among 18–24-year-olds, the age group statistically most likely to pirate. Based on the responses, I proposed
two separate types of music consumer, differing mainly in their consumption patterns: one group has a voracious appetite for music, and tends to download whole albums; the other group is less involved overall, and generally purchases individual tracks. I then conducted two studies targeting the groups with music albums with different bonus features, such as “a chance to meet the artist.” In these two studies, the bonus features increased album downloaders’ likelihood of purchasing by 15%, and the bonuses made single-track downloaders as much as 30% more likely to buy a full album. These initial findings suggest a possible future for music albums, in that targeted non-transferable features can convince consumers to buy—and to buy more—instead of pirating.

Project Title: Saving the Music Industry: Can Value-Added Offerings Increase Album Sales? Advisor: Rebecca Naylor

The Somali wild ass was domesticated over 6,000 years ago by the Egyptians, but attempts to domesticate the zebra have failed time and again. I spent the summer of 2010 as an animal behavior research intern at the Saint Louis Zoo and explored potential reasons for this difference. Working with a small team of interns, I observed the wild asses and zebras and either identified the individuals, called out behaviors as they occurred, or recorded the behaviors on a data sheet. I spent the first week of my internship learning to distinguish the individual wild asses and zebras. At the end of my second week, I successfully completed the inter-observer reliability test and was subsequently able to collect data for the zoo. During my experience at the zoo, I came to appreciate the unique personalities of the animals and enjoyed the thrill of knowing that each passing day’s data collection would bring a new set of surprises. In the limited set of data that I was able to analyze, it appeared that the wild asses may be more adaptable to living around humans and therefore more receptive to domestication efforts.

Project Title: Comparative Behavior of Grevy’s Zebras and Somali Wild Asses Advisors: Pasha Lyvers Peffer and Cheryl Asa

What’s next? In November 2011, Drew will present his research at the University of São Paulo as part of the Brazil Research Exchange Program.

The Mystery of the Intractable Zebra

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Elan Lieber, ’12 (Exercise Science Education)

My research focuses, in more ways than one, on increasing health through body awareness. I have been doing my research at Ohio State’s Labs In Life @ COSI, a state-of-the-art research facility located in three glass pods inside a children’s science museum. COSI visitors are able to watch and participate in research vital to the community. This lab is truly the first of its kind, and by demonstrating to the public we enlighten visitors on the importance and value of our work. My own research looked at the relationship between fitness testing and physical activity. We used technology and individual feedback to help boys 6–17 years old learn about their bodies, and administered questionnaires to them both before and after fitness testing, asking them whether they intended to exercise. We found that the boys had a much stronger intent to participate in physical activity following testing procedures. This type of personalized education seems to make a positive impact on the boy’s intent to engage in physical activity. As such, we would suggest that personalized assessment of body measurements and fitness using technological devices may be a useful way to improve physical activity habits in male children and adolescents.

Project Title: The Influence of Body Awareness on Physical Activity Behaviors
Advisor: Carmen Swain

What’s next? Elan plans to pursue a master’s degree in either public health or exercise physiology, eventually leading to a career in the National Institutes of Health or the Centers for Disease Control and Prevention.

What’s for Dinner? A Look at Prehistoric Hawaiian Fishing

Jacqueline Lipphardt, ’12 (Anthropological Sciences)

Fish were an important dietary staple in Hawaiian prehistory. The Hawaiian Islands were colonized relatively recently, around AD 1200, and from colonization until European contact, the socio-political organization of the archipelago became increasingly complex—some researchers have referred to Hawaii as an “archaic state.” The Hawaiian chiefs demanded surplus from the population, such as fish and agricultural products. The
population was growing, and prehistoric Hawaiians had to produce enough food to feed the growing population and to comply with the demands of their rulers. My project looked at changes in the use of fish over a 400-year period in Kohala, Hawaii. The goal was to analyze changes over time in the species used and the size of the fish consumed, which would allow us to know if people were overfishing in prehistory, and if the fish populations were declining over time. I performed this project by analyzing skeletal fish remains recovered during archaeological excavations in Kohala. After using statistical tests to analyze changes in the fish consumed over time, I found no evidence for overfishing or resource depression in Kohala. This conforms with other researchers’ conclusions throughout the islands—that agricultural production and surplus was becoming more important through time.

Project Title: Examining Impacts of Marine Foraging Strategies in Prehistoric Hawaii
Advisor: Julie Field

What’s next? Jacqueline plans to go to Hungary to do fieldwork the summer after she graduates. She is applying for a Fulbright grant to conduct research in Hungary for a year after graduation, and plans to pursue a PhD in anthropology.

Water Pumps for Third World Aquaponics Systems

Son Ngo, ‘12 (Mechanical Engineering)
Amanda Peterson, ‘13 (Food, Agricultural, and Biological Engineering)

Students from Ohio State have been doing service-learning work in Honduras since 2005, enhancing the lives of the Honduran people through technology. This year, we built a simple inexpensive aquaponics system to produce a supplemental food supply (fish and vegetables) for a typical single-family Honduran household. An important component of an aquaponics system is a pumping mechanism that circulates water and plant nutrients between the fish tank and vegetable grow beds. An aquaponics system is sensitive to interruptions in this water/nutrient flow, so the pumping system must be reliable and must include a backup capability in case the primary pump fails. Because Honduran electricity is expensive, unreliable, and unavailable in the rural areas of the country, we constructed a solar-powered primary pumping system along with a simple manual backup pumping mechanism. The solar panel charges a storage battery and powers the water pump during the day. The battery

(continued)
powers the pump during the night. The manual backup pump is a clever piston-driven device made from PVC tubing and two one-way valves. The entire aquaponics system is simple, low-cost (<U.S. $400) and can be built entirely from locally available parts. The system has been running flawlessly in Choluteca, Honduras, since spring break.

Project Title: **Sustainable Water Pumps for Aquaponic Systems in Honduras**
Advisor: Roger Dzwonczyk

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**Charting the Course of Columbus’s Somali Population**

Shannon Oakes, ’11, and Allison Myers, ’11 (Architecture)

Columbus has the second largest Somali population in the United States. Currently there are more than 45,000 ethnic Somalis living right here in central Ohio. The majority of refugees have come through refugee camps and family programs. We want to generate conversations about cultural integration within our community and to promote awareness of Somalis as our neighbors. We hope to bring to light the plight and resiliency of the refugees on their journey here. The Somali Documentary Project (SDP) has been documenting this struggle for eight years. With its help, we have been able to provide a personal perspective into the lives of Somalis in Columbus. SDP has graciously allowed us to utilize it as a tool to obtain the bigger picture, enabling us to view a very personal and raw story of Somalis through their established relationships. Our project was exhibited through three different mediums and portrayed our concept on several scales. One aspect of our project was a documentary including footage of an interview with a local Somali refugee (Mohamed) who is now living in Columbus. We also used printed materials to illustrate statistics and overall characteristics of Somalia and its immigrants. The final piece of our project was a large-scale floor map displaying routes taken by many Somali refugees, including the specific route taken by Mohamed.

Project Title: **Somali Experience in Columbus**
Advisor: Kay Bea Jones
Max Reisinger, ’10 (History and Political Science)

My project analyzed how six Ohio newspapers (Cincinnati Enquirer, Cleveland Plain Dealer, Columbus Evening Dispatch, Akron Beacon Journal, Toledo Blade, Cleveland Call and Post) and the Chicago Tribune covered the Birmingham protests in 1963. Surprisingly, little research has focused on how the civil rights movement was covered and reported to Americans. I examined these seven newspapers’ archives from May 2, 1963, through June 18, 1963, and recorded any and all coverage of these events. My goal was to discover the quantity and quality of information about the Birmingham protests presented to a typical Ohioan through his or her local newspaper. Although the Cleveland Plain Dealer and Toledo Blade provided more sympathetic coverage than the Cincinnati Enquirer, all of the newspapers thoroughly covered the Birmingham protests. Ohio newspapers, however, largely ignored and rarely reported on civil rights protests happening in Ohio during the same time period. The editorial boards of the analyzed newspapers were far more supportive of the Birmingham protesters than the protesters in their own backyards. This research was a tremendously rewarding activity, from poring through decades-old newspapers to writing my report, to presenting and discussing my conclusions with anyone who will listen.

Project Title: Ohio Newspapers’ Coverage of the 1963 Birmingham Protests
Advisor: David Stebenne

What’s next? Max is currently pursuing his JD at Ohio State.

Talking Research on Sidewalks and in Fruit Markets

Justin Schulze, ’12
(International Studies—Development and Economics)

For my research, I traveled to Ecuador and Bolivia to interview indigenous migrants who had moved from the countryside to the city. Specifically, I wanted to know why the migrants came to the city, how they identified themselves once they arrived, and whether they wanted their children to be educated in the traditional indigenous language. In order to speak with migrant parents, I had to conduct my interviews in the communities where they worked. I often found myself recording conversations (continued)
with individuals as they sold their wares and products on a busy sidewalk or in a crowded fruit market. Ultimately, I discovered that most migrants moved to the city because their rural family farms had become an unsustainable and unpredictable source of income. When they arrived in the city, however, the migrants retained a strong sense of indigenous identification, and they still wanted their children to learn indigenous languages in school. Unfortunately, few indigenous language schools existed in the cities, and most parents lacked the information or resources necessary to enroll their children in those schools.

Project Title: **Bilingual Education and Human Rights in Two Urban Indigenous Communities**  
Advisor: Ulises-Juan Zevallos-Aguilar

**What’s next?** After graduation, Justin hopes to join Teach for America and begin a lifelong career in reforming American K-12 public education.

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**Pass The Pork Chops, Please!**

**Kathleen Shircliff, ’11** (Animal Sciences)

My research attempted to characterize differences in tenderness and fresh meat quality due to maternal breed influence in pork *longissimus dorsi* (aka pork loin). A Berkshire boar was bred to three sows, a Berkshire, a Landrace, and a Berkshire/Saddleback cross. Pigs from each of the matings were housed together and harvested at approximately 220 pounds. At 24 hours post-harvest, we measured back fat and loin eye area, and evaluated the quality of the meat by assessing the marbling, color, firmness, and wetness of the loin surface. A sample of the pork loin was aged for seven days and then tested to measure the tenderness and amount of marbling in the chop. We used PROC CORR procedures in SAS to determine simple correlations among breed, tenderness, and other pork quality and yield measurements. The mother’s genetics had no significant effect on back fat, loin eye area, visual marbling, firmness and color, or marbling. However, maternal genetics did affect ultimate pH, visual firmness, and the tenderness of the loin chops. Thus, we conclude that meat quality and palatability are positively affected by Berkshire and Berkshire x Saddleback maternal genetics, which has implications for future breeding choices.

Project Title: **Maternal Line Genetics Influence Fresh Pork Quality and Palatability**  
Advisors: Henry Zerby and Steven Moeller

**What’s next?** Kathleen plans to pursue a master’s degree in meat science and hopes to continue her involvement with youth development as a coach for collegiate livestock or meats teams.
Breonna Slocum, ’13 (Microbiology and Spanish)

Have you ever gotten an ear infection—or had some other encounter with a bacterium—and wondered what was going on behind the fever and headache? Using *C. elegans*, a nematode (roundworm) as a model system, we examined what happens in a host in response to a bacterial infection. We identified genes whose expression patterns changed when the nematode was infected with a soil bacterium called *M. nematophilum*, and compared those to genes that were under the control of a transcription factor that is important for regulating hindgut development in *C. elegans* called EGL-38. We found that three of the genes that matched up were also involved in the production of an enzyme that is important in fatty acid metabolism, acyl-coA. We then decided to look at the expression pattern of these genes in response to infection by individually attaching the protein products of the genes with a green fluorescent protein (GFP) so that we could visualize them underneath a microscope. At first, we expected to see the fluorescence in hindgut cells because of the nature of the transcription factor, but instead we saw it in neurons, which was surprising. It was even more exciting when I noticed that many of the *C. elegans* worms showed a high level of fluorescence in epidermal cells, because it gave us a new research focus.

Project Title: **A Nice Worm Place: Identifying phenotypic response to genes altered in *C. elegans* in response to bacterial infection**
Advisor: Helen Chamberlin

Jeffrey Thompson, ’13 (Geological Sciences)

Crinoids, relatives of starfish better known by their common name of sea lilies, were common members of ancient seafloor communities. Although they were common in much of the prehistoric world 400 million years ago, there is little known about fossil crinoids from the South American country of Bolivia. It is important to continue to increase our knowledge of fossil creatures so that we have a better understanding of the prehistoric world. With more information about fossil organisms, we can better understand the ecology of ancient environments and habitats, as well as evolutionary relationships throughout time. This project involved describing four new species of Bolivian fossil crinoids by carefully examining the specimens with microscopes and hand lenses and determining what types of crinoid they are. The results of this research indicate that there are probably more fossil crinoids from Bolivia than originally thought, and that Bolivia may be important in the expansion of known crinoid species.

Project Title: **Four New Crinoids from the Lower Devonian of Bolivia**
Advisor: William Ausich

What’s next? This project has yielded a paper, which will be submitted to the *Journal of Paleontology* in September for future publication.
Elaina Voyk, ’11  
(Anthropology) 

My research seeks to explain why orphans are the most vulnerable people in Ghanaian society, even as funding agencies and NGOs (non-governmental organizations) continue to give resources to orphanages in the country. I explored this issue by traveling to Asebu, Ghana, and using traditional anthropological research methods: interviews, participant observation, and literature review. I found that NGO influence in orphan care rose with the increase of HIV/AIDS rates. NGOs favor orphanages as they are easy to fund and seem to be a “quick fix” for orphan care. However, they ultimately cause more harm than good. Orphanages provide orphans with food, education, and material goods. This creates a “privileged” lifestyle compared to the locals, which spurs jealousy and envy from the community. Perhaps more important, however, is that orphanages undermine Ghana’s matrilineal kinship system. Kinship groups provide their family members with aid, benefits, property rights, marriage partners, and, most importantly, a social identity. Without a social identity, orphans cannot be viable members of society once they are grown, as they have no place in any community and have no support system from a family. Action needs to be taken now, not only to promote well-being for all Ghanaian children, but also to reduce the expected complications that a generation of 1.1 million identity-less orphans will create.

Project Title: Kinship: Explaining Orphan Vulnerability in Ghana 
Advisor: Jeffrey Cohen 

What’s next? Elaina is applying to graduate school programs in maternal and child public health.
The initial goal of this research was to discover the interplay between dance and skydiving. I wanted to meld different fields of physicality in order to make dance more accessible to an audience that may not ordinarily be inclined to attend an arts event. I began by taking dance movement from the rehearsal studio and essentially throwing it out of a plane. I knew that it would be disorienting and likely not look the same, but I grossly underestimated how difficult executing the movement would be. Using those results, I worked with a cast of dancers to recreate the skydancing experiences on the ground. In rehearsals I worked with the dancers through video briefings and conversations of skydiving to help them embody sensations they had never experienced. This communication was one of the most difficult aspects of the process. Towards the end of the process I took the cast of dancers skydiving. This experience completely changed the way the dancers physically approached the movement and the final work became cohesive. After completing this project, I have come to the conclusion that movement cannot remain the same in an arena other than the one it was created in except for its intention; the appearance and the sensations will alter drastically.

Project Title: **Dance Diving: The Relationship between Movement and Arena**  
Advisor: Esther Baker-Tarpaga

What’s next? Arianna is currently working at a skydiving center as events coordinator and coach while training for the United States Parachute Association’s National Skydiving Competition in the discipline of 4-way.
DeWayne Williams, ’11, and Sean Plaskett, ’11 (Psychology)

Who knew that performing well on challenging tasks was associated with the rhythm of the heart? Our research revolved around the idea that variability in the time between heart beats can be a useful measure of cognitive and attentional capabilities. This measure, heart rate variability, is associated with the parasympathetic (PNS) branch of the autonomic nervous system. Unlike the fight-or-flight system, which is largely controlled by the sympathetic branch, the PNS has been described as the “Rest and Digest” system and works to lower heart rate after we’ve escaped that saber-tooth tiger. Using an electrocardiograph (EKG), we collected resting heart rate data on over 70 Ohio State undergraduates, who also completed a computerized detection task. Our results suggest that the higher one’s resting heart rate variability, the better one performs on these tasks. Interestingly, this was not the case for individuals from minority groups and women, who did not perform as well as Caucasian male students. In agreement with prior research, additional results revealed that women and minorities in our study were at least partially distracted by internal levels of stress and anxiety while completing the task. So, in addition to studying hard, learn to relax a little before your next exam!

Project Title: The Influence of Heart Rate Variability, Race, and Gender on Cognitive Performance
Advisor: Julian Thayer

What’s next? DeWayne is pursuing a PhD in psychology. Sean is participating in Teach for American in Houston, Texas, after which he plans to go on to graduate studies.
An ancient enzyme found in virtually all living organisms, RNase P is vital for preparing the cell for protein synthesis. RNase P is composed of two types of biological molecules: protein, the standard workhorse of the cell; and RNA, a sister molecule of DNA, the relatively stable and inert genetic material. Interestingly, the portion of RNase P that is actually chemically active in carrying out the reaction has been shown not to be the protein, but the RNA. The use of RNA as more than a docile information carrier has interesting implications for the evolution of enzymes as well as the role of RNA—traditionally viewed simply as DNA’s more unstable relative—within the cell. The goal of this project is to investigate the interplay between the RNase P RNA and proteins through the reconstruction of the RNase P holoenzyme from the mesophilic archaeon Methanobrevibacter smithii. Since M. smithii also has been implicated in obesity, the ability not only to build up but to tear down or inhibit the vital RNase P holoenzyme of this organism also may provide a target for the development of anti-obesity therapeutics.

Project Title: Methanobrevibacter smithii RNase P: a Model for Archaeal Mesophilic Type A RNase P and a Possible Anti-Obesity Target
Advisor: Venkat Gopalan

What’s next? Emily is currently pursuing her PhD in Yale University’s Molecular Biophysics and Biochemistry program.