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1 From the Dean

It is my pleasure to welcome you to *Incite*. In this journal you will find wonderful examples of the undergraduate research and creative activity in the Cook-Cole College of Arts and Sciences at Longwood University. The faculty of the college and I are extremely pleased to be able share the work of our students with you.

Longwood University has a tradition of cultivating a stimulating and effective learning environment through the dedication of our faculty and the close personal attention they give each student. This tradition is amplified and enhanced by the scholarly and creative work of our faculty as they explore new ideas and techniques in their disciplines.

In *Incite* you will find some of the results of our efforts to give our students the opportunity to become scholars in their disciplines. In our college, we are making an effort to give as many students as possible the chance to experience the excitement of generating ideas and creative works that are not only new to the student involved but to the discipline as well. We feel that when a student has the chance to stretch his or her abilities by working closely with a faculty member on a rigorous project, it is the perfect complement to the college's excellent classroom instruction.

One of the joys of my role as dean is having the chance to learn more about the many fields of study that comprise the Cook-Cole College of Arts and Sciences. As you read through *Incite*, I believe you will get that same sense of enjoyment from the wide variety of student work contained in the journal. Here you will find everything from work on a nuclear fusion reactor to poetry and paintings. The DVD included with the journal showcases the work of our student thespians, musicians and creative writers.

Our mission is to provide our students with both a solid liberal arts foundation and a deep understanding of their chosen discipline. I believe that *Incite* provides solid evidence that we are achieving our mission. We also hope that our students and faculty find a love of learning that lasts a lifetime and that the collaborations highlighted in these pages are just first of many such explorations to come for all involved.

Thank you for your interest in our students and for taking the time to investigate what they have created. In addition to thanking the student authors and

artists and their faculty mentors, I must express extreme gratitude to Mary Carroll-Hackett and graduate student Austin Eichelberger from the Department of English and Modern Languages and Dr. John Graham of the Department of Mathematics and Computer Science. Without their talent and tireless work, *Incite* would not be the beautiful work that you now hold in your hands.

Sincerely,

Dr. Charles D. Ross
Dean, Cook-Cole College of Arts and Sciences

2 Feature Article

Three Decades of Digging: Undergraduate Archaeology at Longwood

Jessica Fields and Stephanie Neeley
Faculty mentors: Dr. Brian Bates and Dr. Jim Jordan
Department of Archaeology

Abstract

The Longwood Archaeology Field School offers to its partakers the facilities to gain experience in an archaeological field setting, to network, and the potential to get ahead of others in the job market. These priceless gifts are spread over thirty years of participants digging at over seventy different archaeological sites. Longwood's unique undergraduate research program transforms these students with these experiences and the knowledge they gain there, giving people from all majors the opportunity to learn the necessary skills to work on and run archaeological sites.

Longwood offers many research opportunities to her students. All students are required to have first-hand experience in their major in the form of an internship, ensuring that alumni will have field experience. In the past twenty-eight years, the Department of Sociology, Anthropology and Criminal Justice Studies has sent nearly 1,000 students to its Archaeology Field School, providing students opportunities not usually available in undergraduate programs. The classic archetype of an archaeologist is that of Indiana Jones and the movies have done much to make archaeology seem glamorous; however, the Archaeology Field School creates a much more realistic experience for students.

As an example of recent research in Longwood Archaeology, in the spring of 2006, three classes of students carried out fieldwork in Westmoreland County. Two of the classes, Dr. Brian Bates' Senior Seminar in Anthropology and Archaeological Field Methods classes, performed a Phase I excavation in a field located

at Longwood's Hull Springs Farm. Phase I research consists of Shovel Test Pits every fifteen meters or so, searching for any archaeology under the soil. For a number of students, these four days on the Northern Neck crystallized their desire to become anthropology majors. It was more than merely digging holes in the hot sun; it was the thrill of the hunt for knowledge of the past that drove these students.

Fall 2007 saw a group of Dr. Jim Jordan's Honors Introduction to Anthropology class, with students from eight different majors, working at Nomini Hall in Westmoreland County, helping to uncover the mystery that lies underground there. These students from Dr. Jordan's class were sent out of their usual element, into the field, to do something they'd never done before, and perhaps had never expected to do in their time at Longwood. They, along with Dr. Bates' Archaeology Laboratory Methods class, spent four days on the Northern Neck, with trowels and buckets, working to slowly peel back the sod and dirt over the enigmatic bricks of a 300-year-old schoolhouse. Their work was documented in an article in the Fredericksburg *Free Lance-Star*, which showcased the excavation and the students involved as vital to the discovery of what remained beneath the dirt at Nomini Hall. This is just the latest in a long line of over seventy articles published about the Archaeology Field School.

Louis Franzel, a physics and mathematics major who worked on his first field project with his Honors Introduction to Anthropology class at Nomini Hall, thought that the project was more than worth the effort. The project on the colonial plantation touched his life in his majors, both of which are quite different from anthropology and archaeology. "Sometimes," he said, "I will be doing something like a hard math [or] physics problem and I will take a step back and really analyze it. Like with the wall and artifacts [at Nomini], I sit and try to analyze what I can really pull from the pieces given to me and make a complete picture with it." Spending four days in Westmoreland County doing archaeology was, according to Louis, a once in a lifetime sort of trip.

During that trip to Westmoreland County, Dr. Jordan said something that many people said stuck and rang true: "You're a field archaeologist. You're what everyone always wanted to be. You gotta remember that." To those who want to continue in this field, this strikes deeply. Among many anthropology majors, it seems to be the general consensus, stated by Jamie Mesrobian and Lyndsay Green,

two senior anthropology majors, that their love for the discipline is all because of Dr. Jordan, and they hope to reach the level of passion he has.

Dr. Jordan, who founded the Archaeology Field School in 1980, has been teaching at Longwood since 1978. Twenty years later, when Dr. Brian Bates, a Longwood and Archaeology Field School alumnus, returned from the University of London with his Ph.D., he took over as Director, and the program is still going just as strong. Excavations began at the Randy K. Wade site in Charlotte County, Virginia in 1998, and every summer since, groups of students have ventured into central Virginia to uncover the mysteries there. In the summer of 2007, nineteen students camped out at the field house in Halifax County, spending their days in a hay field, using their trowels and buckets to unearth what lie beneath the dirt there. The Wade site, now in the Phase III stage, or data recovery, is going into its tenth year of excavation. The late Woodland Indian site is located just north of the Staunton River in Halifax County.

Jamie Mesrobian, who spent her first summer at the Wade site in 2007, expected to enjoy doing [the archaeology], but not to the extent that [she] did. Jamie, a senior who has been doing archaeology for two years now, knew that she needed to experience a field project at Longwood at least once in her life. "If anything," she said of her time in Charlotte County, "it confirmed that anthropology was the right choice and that this was what I really wanted to do." This thought was shared by many of the participants. Ryan Buchanan and Jessie Thacker, who also worked at the Wade site this past summer, agreed that the work was both rewarding and empowering. Jamie knew that her future was decided for her when she could look back and remember everything [she] learned about archaeology, [her] love of archaeology and of [herself].

Ryan Buchanan, a senior who will graduate in May, knows that when he gets to graduate school, he will have the edge over peers who do not have first-hand experience in field research. Longwood provides him the opportunity to get ahead in his major by challenging him as an undergraduate in ways that many schools do not. Jessie Thacker, who has two more years at Longwood, spent her first summer as an undergraduate on the Wade Site, an experience which confirmed that [she] wants to do archaeology as a profession. This seems to be a common theme from alumni of the site.

In the summer of 2007, Dr. Bates also took seven students to the British

Virgin Islands to excavate at the Cape Wright site on the island of Jost Van Dyke. Lyndsay Green, a senior, wasn't daunted by the amount of artifacts found on the site over the four weeks spent in the Caribbean. Having numerous artifacts only made her more determined that she wanted to spend her post-graduate career in finds processing and artifact analysis. Since its inception in 1980, the Archaeology Field School has surveyed and excavated approximately seventy sites.

In the field, anthropology students gain insight into techniques that are important for exposing and properly documenting artifacts. They also learn specific techniques and skills associated with archaeological excavation. Justin Patton, who dug in 1986-87, says that he was interested in the techniques and the reasons why they were employed in the field.

Besides the opportunity to learn excavation techniques, students have the opportunity to learn more about the people and the culture they are studying. Megan Richardson, who attended several field schools in the mid 1990s, became very interested in prehistoric Native Americans and felt that the field school was a good opportunity because you can learn so much more than what is taught in a textbook. "Just holding an artifact in your hands," she says, "is different than reading about it in a textbook."

The experiences that students take away can be as important as the lessons they learn in the field. Many people come away from the Archaeology Field School with a new outlook on life. Megan Richardson, for example, felt that the field school changed her philosophy on life. She felt that it taught her that how she lives her life is important. The field school can also provide a setting in which students can network with others. Lasting friendships are formed and students can gain important social skills. Justin Patton felt that he made many friends during his archaeology experience. Most important are the learning experiences taken away from field school. Many did not enroll in a classroom archaeology class before. Therefore the field school was, in effect, their introduction to one of the four branches of anthropology.

For those who have had previous basic exposure to archaeology in the classroom, the Archaeology Field School is a chance to get an authentic hands-on experience. An open field is a much different setting than a classroom with tables and stools and a trowel is a much different tool than a pencil. Analyzing artifacts in a field setting is a different challenge. In many cases the artifacts have to be

left *in situ*, or where they were uncovered. Students also learn the do's and don'ts of an archaeological site, and basic archaeological etiquette, something that isn't necessarily learned from the pages of a book, yet is still just as required on site. For example, students learn not to tread on recently troweled parts of open units, or that sitting along the edge of a deep unit could cause the wall to cave. It may seem simple, but it is vitally important.

Yet, not all of the work involves dirt and trowels. At the Wade Site in the summer of 2007, Dr. Bates assigned each student a topic which they were required to research and then present it to the rest of the crew. This involves the archival research side of archaeology. This helped cultivate the students' ability to research a particular subject and the ability to link their information to a specific archaeological site. Students present research on things from ceramic pot-making to basketry to historic settlement patterns of Europeans in the area. Archaeology helps to preserve cultures and that is one focus of the field school.

Field school is vital in helping students prepare for their future. Justin Patton has held a job in cultural resource management for almost twenty years and knows that the field school helped prepare him. Megan Richardson believes that "professional archaeology is different" than simply what is taught in college. She says that professional archaeology can be more meticulous than field school archaeology. She held a job as a contract archaeologist for a number of years. Many Longwood students in the anthropology program plan to secure jobs in archaeology and the field school gives them valuable experience. This can be important to help them decide if archaeology is their cup of tea. It is important that they make an informed decision so that they can begin the training for their futures.

The Primitive Technologies Club is another important aspect of the Archaeology Field School. Prim Tech, as it is known, is an experimental archaeology club where the members learn to make prehistoric tools, such as projectile points (arrowheads), pottery, and baskets. The club is entering its tenth year on campus and has become a part of the campus life. Jessie Thacker, the president of Prim Tech, said that she made lasting friendships through the club. Jessie says that Dr. Jordan was the first to inform her about the club. She hopes to become an archaeologist and she believes that her experiences in the club will help her in the field. As president she also hopes to expand interest throughout campus, so that other students will realize that the club is not just for anthropology majors.

The Longwood Archaeology Field School has gained fame state-wide, and is geared in such a way as to be attractive to students of any major, as well as people outside of the university. Past excavations have been conducted at such a time to coincide with, for example, the Heart of Virginia festival in Farmville, to attract as many visitors as possible, and open their eyes to archaeology. The Wade site, situated on the grounds of the Staunton River Battlefield State Park, is open to visitors a specific week of each dig season. An entire visitor center is dedicated to artifacts found on the site, and to the Saponi Indians who once inhabited this land just north of the Staunton River. Hoards of elementary school children from neighboring counties stop by, their eyes wide, and their hands ready to get dirty. They are handed trowels and taught exemplary field techniques by the university students who thus become teachers to the less experienced.

Longwood's Archaeology Field School transforms students into something they never expected - from a rookie with no experience to someone able to run an archaeological site themselves, Longwood boasts alumni who have done everything from contract archaeologist to museum curator. Without the ability to do undergraduate research, many students would not be where they are today.

Every student at Longwood University should consider the Archaeology Field School as an internship possibility. The rewards are endless, and, as a field archaeologist, remember the words of Dr. Jordan: "You're what everyone always wanted to be." What more could you ask for?

Student Biographies

Stephanie Neeley is a Sophomore Anthropology major from Ashland, Virginia. She is the current Historian for the Primitive Technologies Club and upon graduation plans to attend graduate school to study Forensic Anthropology.

Jessica Fields is a senior at Longwood, graduating in 2009 with a BA in Anthropology and a minor in English. She grew up in Chesapeake, Virginia, surrounded by information about the Revolutionary War-era Battle of Great Bridge. Growing up in an area with such a rich history led her to the Anthropology department at Longwood. After graduating, she hopes to go to graduate school to study artifacts and material culture.

3 The Natural Sciences

Interactions of Allelopathy and Heat Stress in Plants

Derek W. Hambright and Mary E. Lehman
Faculty Mentor: Dr. Mary Lehman
Department of Biological and Environmental Sciences

Abstract

Allelopathy involves the interaction of plants through the release of biochemicals into the soil, often negatively affecting the growth of surrounding plants. Little is known about how other plant stresses interact with allelopathy. Cucumber seedlings were grown in nutrient culture systems containing 0 – 0.6 mM *p*-coumaric or salicylic acid, two common allelopathic chemicals. The seedlings were also exposed to heat stress simultaneously with or following the allelochemical stress (36/32 ° C. day/night compared to control temperature of 26/22). Both salicylic acid (SA) and *p*-coumaric acid (PCO) inhibited the shoot and root growth of cucumber seedlings. The consistent main effect of heat stress was a significant reduction in root growth at the high temperature (36/32°C). There also were alterations of the growth patterns of cucumber shoots under heat stress. In most cases, no significant interactions were seen between allelopathy and heat stress effects on cucumber seedlings. However, one significant interaction was seen with simultaneous effects of PCO and heat stress on root growth, indicating the potential for interactions of these stresses under some conditions.

Introduction

Allelopathy involves the interaction of plants through the release of biochemicals into the soil, often negatively affecting the growth of surrounding plants. Compounds that are found to influence plant growth and development are termed as

allelopathic [7]. The use of allelochemicals may one day be a safer alternative to herbicides and could benefit agricultural farms in the future. Salicylic acid (SA) and *p*-coumaric acid (PCO) are used as two representative allelochemicals in this study; both are phenolic acids, a common and ubiquitously produced group of allelochemicals. These acids are taken in through the root systems and plants perceive them as stresses. Little is known about how other plant stresses interact in combination with allelopathy. Some studies suggest that allelochemicals could induce tolerance to other subsequent stresses to which plants are exposed, such as heat stress (Senaratna et al., 2000). Growing concerns about global warming indicate that it can be beneficial to observe how plants can deal with allelochemicals and a rise in temperature. Global warming may have an adverse effect on the way crops grow. However, some may see improved growth or suppression under allelopathic conditions. In this study, elevated temperatures are used both sequentially and simultaneously with PCO and SA to determine if there is an interaction between allelopathy and heat stress.

Methods

Cucumber (*Cucumis sativus* cv. Early Green Cluster) was used as a bioassay species that grows quickly and responds to a variety of stresses. Cucumber seeds were planted in vermiculite and were watered daily while being germinated in an incubator for three days at 30°C. On the third day, plant trays were transported to growth chambers with a 12-hour photoperiod, 70% relative humidity, and 26/22°C day/night temperatures, respectively. At five days after planting, the cucumbers were transplanted from their trays of vermiculite into 110 mL glass jars containing standard Hoagland's solution at pH 5.5 [3]. The seedlings were suspended by foam collars placed in holes in the lids of the jars. Each jar was covered with aluminum foil to shield roots from light. Deionized water was added periodically to replace water lost via evapotranspiration.

Two allelopathic phenolic acids were individually tested to measure effects on root and shoot growth as well as interactions with heat stress. The acids used were *p*-coumaric acid (PCO) and salicylic acid (SA), at concentrations of 0 mM, (Control), 0.2 mM, 0.4 mM, and 0.6 mM (dissolved in standard Hoagland's solution

at pH 5.5). Each acid was tested with sequential stresses, with one week of acid exposure followed by one week of heat stress at 36/32°C. Also, for each acid, a separate trial was run with two weeks of simultaneous exposure to allelopathic and heat stresses.

For the sequential stress experiments, all plants were allowed to grow for one week at the standard growth conditions and temperatures (26/22°C day/night) with periodic addition of deionized water to all plants without any additional acid addition. Half the cucumbers were then transferred to a second chamber for an additional week with increased temperatures (36/32°C day/night). The other half remained at the standard temperature of 26/22°C. Leaf length and width were measured at the end of the first week before the heat stress part of the experiment and again at the end of the second week. Leaf length (L; millimeters) and width (W; millimeters) measurements were used to calculate leaf areas using the following formula[1]:

$$leafarea = -1.457 + [0.00769 * (L * W)] \quad (1)$$

Fresh and dry weights of shoots and roots were also obtained at the conclusion of the experiments. Data were analyzed using JMP, Version 6, with a p-value <0.05 indicating statistical significance. The methods used for simultaneous stress experiments were identical, with the exception of plants being left in their original nutrient solution along with respective acid concentration throughout the duration of the experiment.

Results and Discussion

Allelopathic Effects

Both salicylic acid (SA) and *p*-coumaric acid (PCO) inhibited the shoot and root growth of cucumber seedlings. This is reflected in significant relationships between the concentration of the acids and leaf area, shoot dry weight, root dry weight, and total plant dry weight. The only exception to this general trend is that with only one week of treatment with PCO (sequential stress experiment), the effect of PCO on root dry weight was not statistically significant. Overall, the inhibitory effects of SA were stronger than that of PCO (See Figures 1 and 2).

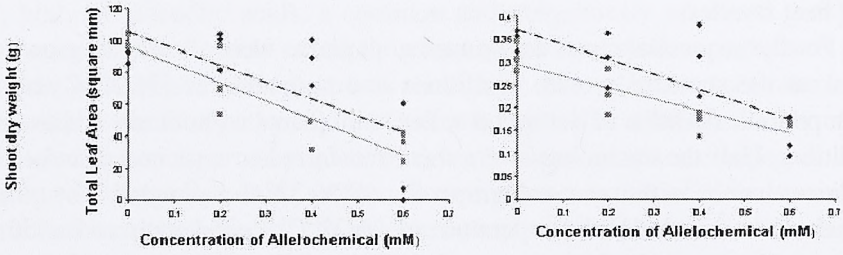

Figure 1: Concentrations of allelochemicals vs. leaf area and dry weight. Dashed lines represent PCO. Solid lines represent SA.

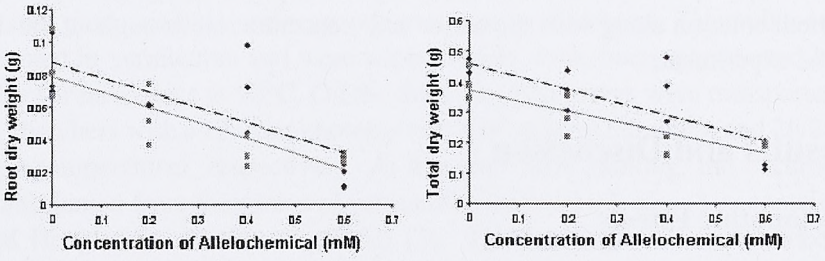

Figure 2: Concentrations of allelochemicals vs. leaf area and dry weight.(continured)

Temperature Effects

The consistent main effect of heat stress was a significant reduction in root growth at the high temperature (36/32°C. day/night). The total leaf areas and shoot dry weights were not significantly different for cucumbers grown under the two temperature regimes. Previous studies also indicated minimal effects of elevated temperatures on shoot growth of cucumbers, as measured by dry weight [6]. However, we did observe some previously unreported differences that indicate differences in the growth patterns of cucumber shoots under heat stress. Cucumbers grown at high temperature typically had four primary leaves of measurable size leaves on lower temperature seedlings. At high temperature, the first and second leaves were significantly smaller than first and second leaves of lower temperature seedlings. However, this reduced expansion of the first and second leaves was compensated by a significantly greater expansion of the third leaf in high temperature seedlings (and by the initiation and expansion of a fourth leaf which was absent in lower temperature seedlings). Additionally, we noted that the leaves of the higher temperature seedlings were darker in coloration than those of the lower temperature seedlings, possibly indicating differences in the production of chlorophyll or other pigments. Temperature effects found in other studies indicate variability in different plant species and even among cultivars of the same species [2] [4] [5] found that a heat shock protein (HSP101) is involved in the development of thermotolerance and this HSP also reduced the primary root growth in maize. It is possible that this HSP, or another similar HSP, is also upregulated in our heat-stressed cucumbers and this could be the cause of the reduced root growth observed in this study.

Stress Interactions

In most cases, no significant interactions were seen between allelopathy and heat stress effects on cucumber seedlings (See Figure 3). However, one significant interaction was seen with simultaneous effects of PCO and heat stress on root growth, indicating the potential for interactions of these stresses under some conditions. We also found no evidence that SA could induce tolerance to subsequent heat stress, as has been previously reported in studies with bean and tomato

plants[8].

Dry Weight Effects						
	Shoots			Roots		
	Allelochemical	Temperature	Interaction	Allelochemical	Temperature	Interaction
SA + Temp Simultaneously	<0.0001***	0.2219	0.4926	<0.0001***	0.0092**	0.2837
SA +Temp Sequentially	0.0001***	0.7809	0.2631	0.0007***	0.0128*	0.679
PCO + Temp Simultaneously	0.0001***	0.9677	0.0849	0.00067**	0.0023**	0.0383*
PCO + Temp Sequentially	0.042*	0.2123	0.3159	0.1384	0.0033**	0.5219

Figure 3: Stress Interactions - p-values listed with levels of significances noted as *$\leq$0.05 ** $\leq$0.01 *** $\leq$0.001

Conclusion

All allelochemicals in our study proved to decrease both shoot and root dry weights, as well as inhibit leaf growth. Heat stress alone significantly inhibited root growth. Heat stress also showed previously undocumented morphological differences. When combined either simultaneously or sequentially heat stress and allelopathic stress showed limited interaction. Further analysis of the potential interaction between PCO and simultaneous temperature stress is needed. Overall induction of tolerance by allelopathy coupled with heat stress requires further study and many avenues of similar research should be considered.

Acknowledgements

I'd like to thank first and foremost Dr. Lehman for her guidance and encouragement throughout the duration of this research. I also wish to extend my gratitude to the Cook-Cole College of Arts and Science for the privilege of presenting the research on which Dr. Lehman and I have worked diligently. Lastly, I would like to thank my mother for her endless support in all my endeavors.

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Student Biography

Derek Hambright is a senior biology major at Longwood University, set to graduate in May of 2008. He plans to attend graduate school for a M.S. after receiving a B.S. from Longwood.

Faculty Biography

Dr. Mary E. Lehman is an Associate Professor of Biology and has been teaching at Longwood University since 1998. Her primary research areas are in plant ecology and pedagogy. She received her B.S. degree from Juniata College in 1991 and her M.S. (1993) and Ph.D. (1998) degrees from North Carolina State University.

Inertial Electrostatic Confinement D-D Fusion Device: Construction and Simulation

Andrew R. Grzankowski
Faculty Mentor: Dr. Keith B. Rider
Department of Chemistry and Physics

Abstract

Increasing the efficiency of Inertial Electrostatic Confinement fusion devices is essential for their successful application as neutron sources and possible instruments of renewable alternative energy. A variation of a Hirsch-Meeks fusor is assembled and the neutron flux is recorded as an indirect measurement of deuterium-deuterium fusion. A model of the fusor is generated in SimIon and deuterium ions are introduced into the simulation environment which allows for extensive ion data collection. After the construction of an IEC device, or fusor, and using ion optics simulation software to model the apparatus, both quantitative and qualitative data is obtained. A simple analysis of simulation data provides a basic depiction of the central processes that occur within the device. The subsequent analysis of data using comprehensive user programs in conjunction with SimIon may produce significant efficiency improvements which can be implemented in the fusor for verification.

Introduction

Nuclear fusion reactions result when two light nuclei collide with very high kinetic energy and fuse to produce a heavier nucleus. This is the ongoing process in our Sun; gravity is compacting light nuclei into such dense regions that fusion is inevitable. An inertial electrostatic confinement device (IEC) uses electric fields to collide these particles. When two deuterium nuclei fuse, the reaction products are

either helium and a fast moving neutron (Equation 1) or tritium and an energetic proton (Equation 2). The kinetic energy of the neutron is much higher than the initial kinetic energy of the deuterium ions, so fusion could, in principle, be used to produce cheap, clean energy.

$$D + D \rightarrow He + n(2.45MeV) \tag{1}$$

$$D + D \rightarrow T + p(3.02MeV) \tag{2}$$

History and Background Information

Philo T. Farnsworth is credited with conceiving the first IEC fusion device(Figure 1). He is best known for inventing the first fully electronic television and the first electron microscope. In the early 1960s, Farnsworth's IEC device was comprised of spherically symmetric ion guns focused toward the center of a vacuum chamber. The ions were further accelerated by a single semi-transparent electrode, a spherical wire grid. Robert L. Hirsch worked with Farnsworth in the late 1960s to construct more practical devices that did not utilize ion guns, but two concentric spherical electrodes, an inner grid for acceleration and an outer ion-producing grid(Figure 2). In this case, they also introduced the concept of recirculation—where ions have multiple chances to collide with one another. Having the chamber act as one of the two concentric electrodes presents some electrical safety concerns but is still practical. This also decreases the amount of grid damage that is a result of a constant barrage of high-energy ions that becomes a limitation in any gridded IEC device.

There are many fuel choices for an IEC fusion device, and the best is not often the most abundant, inexpensive, or safe. Examples include the Deuterium-Tritium, Proton-Boron-11, and Tritium-Helium-3 mixtures. We chose to use the Deuterium-Deuterium (D-D) mixture as a fuel source, which has its own disadvantages and advantages. It is a neutronic fusion fuel, meaning that one of the byproducts of this reaction is a high-energy neutron capable of doing severe damage to biological tissue. Deuterium is also widely abundant on earth and can be easily extracted by heavy water electrolysis, and therefore, is very cheap.

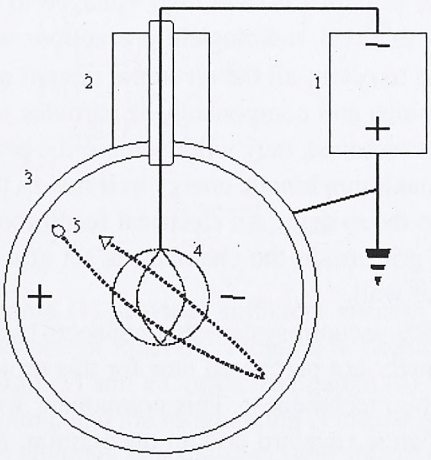

Figure 1: A power source (1) applies a large negative potential to an electrical feedthrough (2) connected to a vacuum chamber. The chamber wall (3) is positive with respect to the small semitransparent inner-grid (4) made of wire at the end of the electrical feedthrough. This grid accelerates positive ions (5) to very high energies and they repeatedly traverse through the center.

Methods

Construction

Before beginning this project, electrical safety procedures were addressed. Voltage and current in the order of that required for fusion is very dangerous; it is possible to be severely injured and can prove to be fatal. With the threat of fast neutrons and that it is possible at such high voltages to encounter x-rays if the device is not properly shielded, radiological precautions were also taken.

In order for fusion to occur, all the air in the system must be evacuated using a series of vacuum pumps and components. If particles other than those used as the fuel source are not removed, they will decrease the probability of an intended particle reaching its maximum kinetic energy as it moves through the center. Deuterium gas is bled into the system. An electrical feedthrough, which is connected to a small Nichrome grid inside the chamber, is set at a high negative potential relative to the chamber wall.

A crucial link in the vacuum system that connects two different sized flanges together was intentionally not purchased new for this project, allowing ample education in machine shop techniques. This component was a full nipple reducer between a common flange standard and an uncommon, archaic flange standard, and included a tube. The uncommon flange was made from a 304 stainless steel plate which was cut with a plasma torch and was finished in the machine shop. The tube was machined from a piece of 304 stainless steel DOM (Drawn Over Mandrel) tubing. A lathe and vertical mill were used to remove excess material from these pieces and the pieces were TIG welded together for use under high vacuum.

Simulation

SimIon is an ion optics simulation program that allows users to model intricate systems and instruments. Electrostatic and magnetic environments are rendered by accessing provided geometry definitions or by creating user-specific geometries; in our case, the creation of an original geometry definition was warranted. Potential arrays are refined by the software, meaning the potential between two or

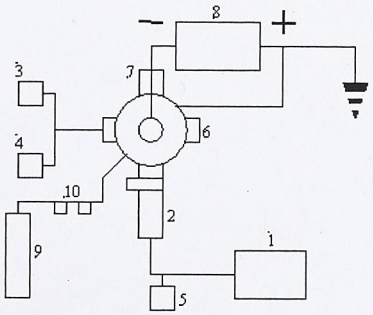

Figure 2: The rough pump (1) provides sufficient vacuum at the diffusion pump (2) outlet required for its proper function. Pressure is measured inside the chamber by a hot ionization gauge (3) and a Convectron gauge (4). The backing pressure between the diffusion pump and the rough pump is measured with a thermocouple gauge (5). The vacuum chamber is a stainless steel sphere with an inner diameter of 4.800". There are a total of 14 ports on the chamber. One port is occupied by a quartz viewport (6) for observation purposes. The topmost port holds the electrical feedthrough (7). A power supply (8) rated at a maximum of 20 kV @ 18 mA provides the negative potential required for ion acceleration. Potentiometers on the front panel control current and voltage input. From the gas storage tank (9), copper Swagelok piping was connected to a variable rough valve for on/off flow control and a much finer needle valve (10) for fine-tuning the gas flow in to the chamber.

more electrodes for every point in the system is determined by solving the Laplace equation. After the refining process, electrodes or poles may be adjusted to any value. Potential arrays are able to be modeled as 3-D virtual images in an ion optics workbench. Inside the workbench, ions are introduced with an initial set of parameters and multiple ion flights are carried out (Figure 4). Ion trajectories are determined using a fourth-order Runge-Kutta method for numerical integration. During each trial, groups of ions are introduced as a spherically uniform distribution about the origin. For every time step in a trial the time of flight, position, velocity, voltage gradient, and kinetic energy are recorded for each ion.

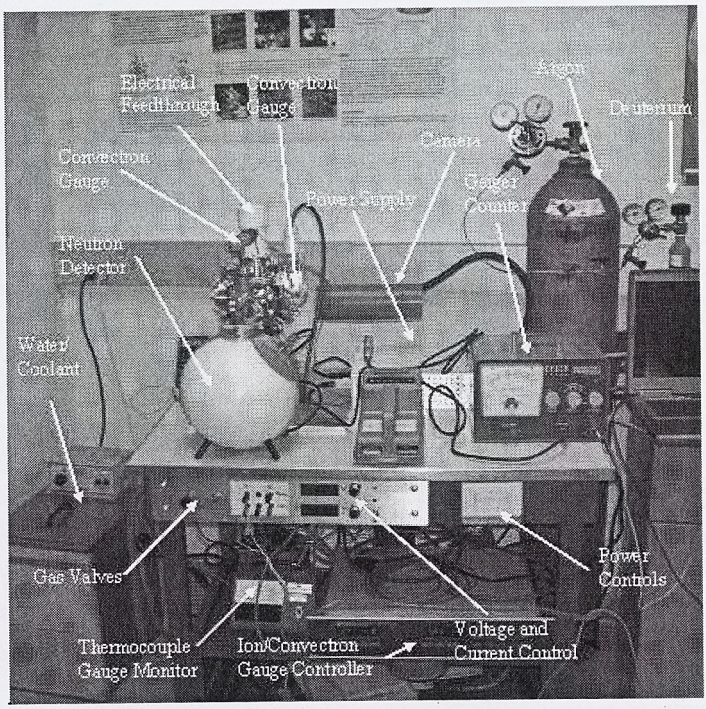

Figure 3: This is the entire fusor assembly in the laboratory. The vacuum chamber is located behind the neutron detector.

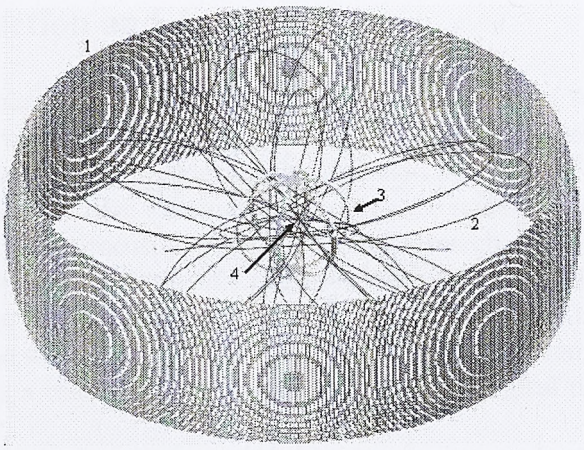

Figure 4: This is a screenshot from SimIon after modeling and simulating this device. The chamber (1) is partially removed for detail purposes. Each red line represents the path of one deuterium ion (2) circulating in and out of the grid (3). There is a region (4) where the density of ions and their kinetic energies are greatest, and where a fusion event is most likely to occur.

Results

No neutron counts have been recorded so far due to an internal defect within the power supply. Previous tests, at lower voltages than those required for fusion and provided by our power supply, have produced both argon and deuterium plasmas—a heated, ionized gas containing nuclei and free flowing electrons. Maintaining stable plasmas is important and requires continuous adjustments of voltage, current, and pressure. Pressure changes with the amount of gas bled into the system and the speed at which it is removed. As higher voltages are reached, ions gather more kinetic energy and will have a greater probability of fusing.

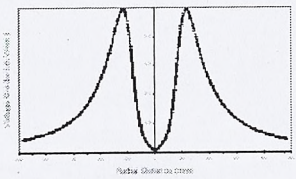

Figure 5: Voltage Gradient as a Function of Radial Distance

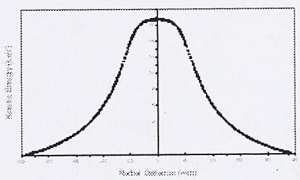

Figure 6: Ion Kinetic Energy as a Function of Radial Distance

Ion data is imported into Microsoft Excel where graphs of the voltage gradient acting upon the kinetic energy of each particle as a function of radial distance from the center reveal the noticeable potential well (Figure 5) and a region where the probabilities of fusion are greatest (Figure 6). This provides a simple, and restricted, understanding of the device. With the possible integration of user-programs in SimIon, an accurate representation of the inner workings can be modeled to include absent physical properties such as mean free path and Coulomb repulsion. With the inclusion of those properties, theoretical neutron counts could be obtained and compared to those of the fusor. The simulation could be conducted under a user-program designed for inner-grid geometric optimization with respect to plasma density or theoretical neutron count. Increases in neutron production efficiency within the simulation can be quantitatively confirmed with the device. Likewise, varying neutron output for different grids in the device can be investigated using the simulation software.

Future Direction and Applications

Current research into increasing IEC efficiencies at University of Wisconsin-Madison investigates the subsequent grid damage under the implantation of various fusion fuels(Figure 3) and neutron production optimization techniques(Figure 4). Simulations of IEC devices have shown that increasing the number of concentric grids increases ion collision focusing(Figure 5). Many research endeavors incorporate students from multiple fields. At Longwood University, computer science students will aid in the completion of an improved simulation to include physical properties not present in the initial simulations. Neutron radiation exposure offers biology students a chance to study its effects on the biological tissues of certain subjects.

The applicability of IEC devices as an alternative power source is still unknown. They are currently used for the production of medical isotopes, neutron activation processes and explosives detection.

Acknowledgements

This project was made possible by funding from Dean Charles Ross. We would like to thank C&L Welding for TIG welding our stainless steel connection and ARCET Welding Supplies for allowing us to use their plasma torch.

Student Biography

Andrew Grzankowski graduated in 2003 from West Springfield High School in Springfield, Virginia. He is a fifth-year Senior at Longwood University and major in Pure Mathematics and Physics. He plans to attend graduate school and pursue a PhD in theoretical or mathematical physics. He is a member of the Society of Physics Students and the Secular Student Alliance, and was a member of the Student Government Association and the Phi Kappa Tau Fraternity here at Longwood University.

Faculty Biography

Dr. Rider graduated with degrees in chemistry and physics from Guilford College, then received his Ph.D. in physical chemistry from the University of California, Berkeley. He joined the faculty of Longwood University in 2001, teaching General Chemistry, Physical Chemistry, and Chemistry for Non-science Majors. His other interests include surface science and atomic force microscopy.

Shackeld Nim

Zachary Johnson
Faculty Mentor: Dr.David Shoenthal
Department of Mathematics and Computer Science

Abstract

The mathematical, two player game of Nim undergoes analysis to create a strategy for both players. A player must determine if their deal, or position, is either balanced or unbalanced by determining the Nim-sum. If the Nim-sum is zero, then a player's position is balanced; otherwise it is unbalanced. If a player is dealt an unbalanced position, they have to opportunity to balance it to take advantage. As well, I conjecture the winning strategy to a variation of Nim, Shackled Nim. This will involve considering the game in modulo residue.

Introduction

My interest in Nim began in a directed study in Game Theory. There I learned how to analyze games, so I began with an analysis on Nim. Nim is a mathematical, two-player game of strategy. During a player's turn, the player will take any amount, one or more, objects (called pearls), from any one row. The winner forces the other player to take the last remaining pearl. The game's name was coined by Charles L. Bouton and evolved from an ancient Chinese game called Tsyanshidzi. Using Game Theory we can model and visualize Nim.

Terminology

To analyze the game of Nim, we need the following terms: directed graphs, trees and subtrees. A directed graph is just a graph with directions associated to each

edge. A tree is a directed graph comprised of roots, edges, and children. A subtree is a part of a tree or a subset of a game tree (See Figure 1)[1].

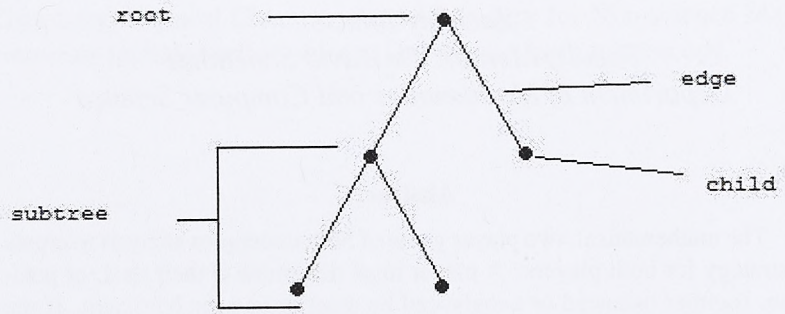

Figure 1: A Sample Tree Structure

Nim Analysis

A simple and popular Nim game consists of three rows, with three pearls in the first row, four pearls in the second row, and five pearls in the third row. (See Figure 2)

Let's create an example initial move. For instance, let's say the first player takes all 5 pearls from the last row, leaving the opponent all the possibilities associated with 3 pearls in the first row, four in the second row, and none in the third row. This tree would look like the Figure 3.

Here (5,3) means that the player took five (5) pearls from the third (3) row. S_3 denotes the subtree with all the possibilities of the game when the game is 3-4.

Given the rules, this particular game would have a tree like the one shown in Figure 4, where S_i denotes the subtrees as described above.

Figure 2: A Sample Nim Game Start Position

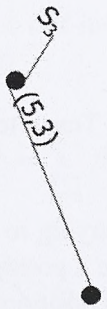

Figure 3: A Nim Move

Each edge in the tree represents a possible move *i,j* where *i* is a number of pearls and *j* is which row. Notice that the tree in Figure 3 is actually a subtree in Figure 4.

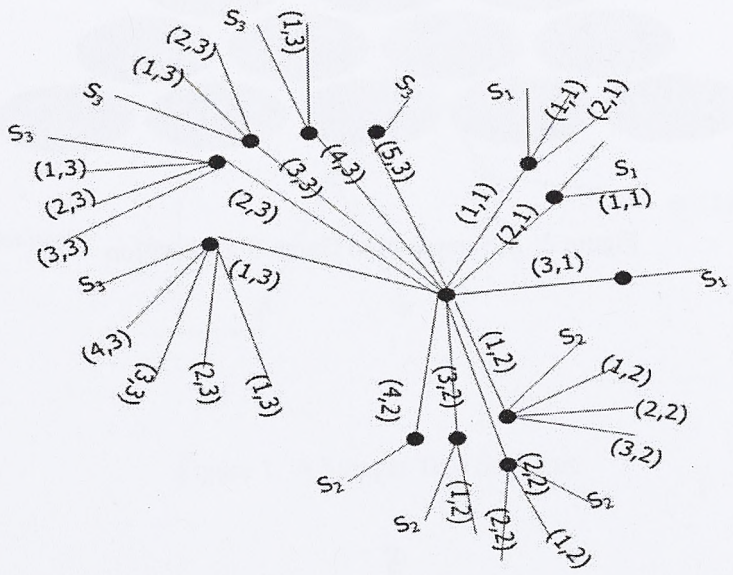

Figure 4: A Nim Tree after several moves

Since trees are a messy way of trying to solve the game, we will use an alternate way of "adding" to determine a position. Positions are either balanced or unbalanced. To determine whether a position is balanced or unbalanced, we render the number of pearls in each row into sums of powers of two. For instance, $3 = 2^1 + 2^0$ If there is an even number of each power of 2 in the game, then the position is balanced; if not the position is unbalanced [2]. Let's determine if the initial turn of the 3-4-5 game is balanced.

$$3 = 2^1 + 2^0, 4 = 2^2, 5 = 2^2 + 2^0$$

There are an even number of 2^0 terms and an even number of 2^2 terms, but an odd number of 2^1 terms. Thus the game is unbalanced.

Another way to determine balanced versus unbalanced is to use the Nim-sum. Suppose $x_1, \ldots, x_n$ are the number of pearls in each row. Let q_i count the number of occurrences of 2^i in all rows of the game. Then the Nim-sum (denoted by $\oplus$) is defined to be

$$x_1 \oplus \ldots \oplus x_n = \sum_{i=0}^{k} (q_i mod 2) 2^i$$

In this formula, k is the highest power of two. From above, we see that the Nim-sum of 3, 4 and 5 is 2.

Properties of Nim-sum

It is convenient that the Nim-sum has several nice properties.

Lemma: The Nim-sum operation is associative, commutative, and the Nim-sum of the same number yields zero.

Below is proof that the Nim-sum is self-invertible. Let b be any position number; we want to show that $b \oplus b = 0$
Suppose

$$b = \sum_{i=1}^{i} \beta_i 2^i$$

where $\beta = 0, 1$ So

$$b \oplus b = \left[\sum_{i=1}^{i} (2\beta_i) mod 2a \right] 2^i$$

Therefore $b \oplus b = 0$

It follows that $b \oplus b = c \rightarrow b = c$ One implication has already been proven. The proof of the other implication proceeds quickly:

$$b \oplus c = 0 \rightarrow$$

$$b \oplus c = b \oplus b \rightarrow$$
$$b \oplus b \oplus c = b \oplus b \oplus b \rightarrow$$
$$c = b.$$

Main Results

We can now use these properties to prove a main result.

Theorem: In a normal Nim game, the first player has the winning strategy if and only if the Nim-sum of the sizes of the rows is nonzero. Otherwise the second player is at an advantage.

Proof of theorem: Suppose $x_1, \ldots, x_n$ are the sizes of the rows before a move. Also suppose $y_1, \ldots, y_n$ are the sizes of the rows after a move. Let:

$\sigma = x_1 \oplus \ldots \oplus x_n$ and $\tau = y_1 \oplus \ldots \oplus y_n$

If a move was in pile k we know that $x_i = y_i \forall i \neq k$ and $y_k < x_k$

So

$$\begin{aligned}\tau = 0 \oplus \tau &= \sigma \oplus \sigma \oplus \\ &= \sigma \oplus (x_1 \oplus, \ldots, \oplus x_n) \oplus (y_1 \oplus \ldots., \oplus y_n) \\ &= \sigma \oplus (x_1 \oplus y_1) \oplus \ldots \oplus (x_k \oplus y_k) \oplus \ldots \oplus (x_n \oplus y_n) \\ &= \sigma \oplus 0 \oplus 0 \oplus \ldots \oplus (x_k \oplus y_k) \oplus \ldots \oplus 0\end{aligned}$$

Therefore $\tau = \sigma \oplus x_k \oplus y_k$

From this we know if $\sigma = 0 \rightarrow \tau \neq 0$ (i.e. we are balanced and the opponent must unbalance it) and if $\sigma \neq 0$ it is possible to make $\tau = 0$ (i.e. we are unbalanced and the player has the opportunity to balance it).

Again using the example of the 3-4-5 game, we know the Nim-sum was 2, so the player presented with a 3-4-5 game would know to eliminate two pearls in a way to leave the opponent with a Nim-sum of zero. The move would be taking 2 from the row of 3 making the game a 1-4-5 and the Nim-sum zero.

Conclusion and Conjecture

One can use mathematics to analyze the best way to play certain games. In my directed study, I investigated how game theory and algebra techniques could be used to determine a winning strategy for the game of Nim.

During my study, I also investigated Shackled Nim, which alters the rules [3] of Nim by bounding how many pearls can be removed from any one row. I conjecture this game is played with a similar strategy to Nim once the number of pearls in each row is considered in mod(k+1) at the beginning of each turn.

For example, let's shackle the 3-4-5 game by 2, meaning a player can take one or two pearls from any one row. So when we render each pile into mod 3, the new game is 0-1-2; from here we play the normal Nim game. I recommend taking one from the last row, making it 0-1-1 in mod 3 or 3-4-4 in the normal game. Notice the Nim-sum now in mod 3 is zero.

Some consequences of the altered rules of Shackled Nim are that piles are no longer strictly decreasing–potentially removal of pearls could increase the size of the row in mod(k+1). For example if the opponent took two pearls in the shackled 3-4-5 game and made the game 3-4-3, then one would have multiple options to balance the game. One could take one pearl from the middle row, or one could take two pearls from the top row. In either event, the game would still be balanced (in mod(3)).

I am investigating and attempting to formalize a proof for shackled nim currently.

Acknowledgements

Acknowledgments go to Dr. Shoenthal for his gracious help with his research and the course in Game Theory. He also wants to thank Brice O'Hara, who worked with him in the Game Theory directed study.

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Student Biography

Zachary Johnson is a Senior Mathematics student here at Longwood University. Originally from Triangle, Virginia, he graduated from Gar-Field Senior High School. Zachary coaches math for The Learning center as well as participates on The Longwood Show. In the future he hopes to become a teacher.

Faculty Biography

David Shoenthal is an assistant professor of mathematics at Longwood University. He received his Bachelor of Arts in Mathematics/Communications at Juniata College in 1998 and his Ph.D. in Mathematics from Penn State University in 2004. His research interests are in differential geometry. He is married and has two daughters.

Development of GC-MS and Chemometric Methods for the Analysis of Accelerants in Arson Cases

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Faculty Mentors: Dr. Sarah E. G. Porter and Dr. Melissa C. Rhoten
Department of Chemistry and Physics

Abstract

There is an interest in the forensic community in identifying accelerants by their gas chromatography-mass spectrometry (GC-MS) profile. In this work, samples of accelerants were analyzed by GC-MS and compared using chemometric methods. Four analytical standards (unweathered gasoline, diesel fuel, kerosene, and mineral spirits) were purchased from Restek®, and regular, mid-grade, and premium unleaded gasoline were purchased at a local gas station. GC-MS analysis was performed on the standards and the gas station samples. The GC-MS chromatograms were assembled into a single data set and compared using correlation coefficients.

Introduction

Arson, the willful and malicious destruction of a building or other property through burning, is one of the easiest crimes to commit, yet it is one of the most difficult to investigate due to the nature of the evidence that remains at the scene.[7] According to the FBI's Uniform Crime Reporting Program, 69,055 arson offenses were committed in 2006[1] This represents a substantial number of crimes which require complex investigations in order to identify the accelerant used and any possible suspects. Because not all fires are deliberately set, it is important to be

able to collect evidence, such as accelerant residues, to prove that the crime of arson was committed.

An accelerant is defined as any ignitable substance (typically a liquid) used to deliberately sustain a fire. Common accelerants include easily obtainable substances such as gasoline and kerosene.[7] Both gasoline and kerosene are mainly composed of low molecular weight volatile, organic compounds. The American Society for Testing and Materials (ASTM) classifies accelerants based on the molecular weight of the hydrocarbons present and the percent composition of alkanes, cycloalkanes, aromatics, and polynuclear aromatics in the mixture.[7] Gasoline is defined as a light hydrocarbon ($C_4 - -C_{12}$) with a low percentage of alkanes and cycloalkanes and a large percentage of aromatics and some polynuclear aromatics. In contrast, kerosene falls into the heavy petroleum distillate category with an abundance of alkanes and cycloalkanes and far fewer aromatic components.[11]

Under ambient conditions both gasoline and kerosene are liquids and easily evaporate. This process, known as weathering, changes the percent composition of the mixture.[7][10] Specifically, the lower molecular weight aliphatic and aromatic compounds evaporate first, leaving behind the heavier components. Samples collected at arson scenes are usually weathered to some extent due to environmental exposure.[8] By comparing standard gasoline samples that have been weathered to a known extent, accelerant residues found at crime scenes can sometimes be identified. A 1993 study found that only 70% of 120 laboratories could correctly identify a weathered gasoline sample using gas chromatography with flame ionization detection (GC-FID)[7] However, some studies have shown that diesel fuel (which is comprised of significantly heavier components than gasoline) weathers predictably and thus weathered samples can possibly be identified.[3]

Gas chromatography with mass spectrometric detection (GC-MS) can be used to identify accelerant residues based on both the retention times (GC) and the mass spectral profiles (MS) of the components of the mixture. Studies have shown that unique fingerprints can be obtained to compare samples from different sources[8] Large databases can be accessed on the web[5] and most forensic labs have their own in-house databases. However, identification based on GC profiles (and consequently mass spectra) usually relies on optimal chromatographic separation of the components in the mixture and highly reproducible retention times. In order

to compare GC profiles between samples, the GC testing conditions must be the same. Even still, retention times of the components can vary significantly between labs and even within the same lab from day to day. These requirements can lead to very long GC runs to achieve separation and the need for hydrocarbon ladders and retention indices to account for retention time shifts. Previous studies have shown that unique fingerprints can be obtained to establish a common origin among unweathered gasoline samples using tetraalkyllead content or focusing on higher boiling components.[8] [4] Samples that are significantly weathered may be more difficult to identify. The mixtures of compounds present in gasoline and other accelerants can be very complex, and it can be difficult to determine which components should be used for comparison.[7]

Using chemometric methods to compare samples offers an advantage over traditional database searching. Chemometrics, broadly defined, is the application of mathematical and statistical methods to chemical data.[6] Well established methods can be used to resolve overlapped chromatographic peaks, compare mass spectral profiles, and align shifting retention times. Previous applications of chemometrics to accelerant analysis include principal component analysis (PCA)[8] , hierarchical cluster analysis (HCA)[2] and covariance analysis.[10][9]

In this work, a fast and robust GC-MS method which separates the major components of gasoline has been developed. Correlation coefficients were used to compare duplicate analyses to show that similar samples can be grouped. The use of correlation coefficients to cluster similar samples negates the need for baseline resolution of the components, thereby minimizing chromatographic method development time. The method will be applied to weathered gasoline samples to determine if the weathering pattern of gasoline is predictable.

Experimental

Four analytical standards (unweathered gasoline, diesel fuel, kerosene, and mineral spirits) were purchased from Restek® Corporation (Bellefonte, PA). Gasoline samples of octane 87, 89 and 93 as well as kerosene and diesel samples were purchased from the local Valero gas station (Farmville, VA). GC-MS analysis was performed on a 30m x 0.25mm x 0.25μm VF-1ms capillary column using a Varian

3900 GC and Saturn 2000 MS system controlled by the Varian MS Workstation (v. 6.6). Split injection (1:100) of the neat standards and samples was performed at 250 °C. The temperature program ran from 50 °C (2.5 minutes isothermal) to 300 °C (5.83 minutes isothermal) at a rate of 15 °C/min. Helium was used as the carrier gas at a flow rate of 1 mL/min. The total run time was approximately 25 minutes. No identifiable peaks eluted after 15 minutes. Chromatograms were exported from the MS Workstation into ASCII format and data analysis was performed in Matlab®, version 7.5 (The Mathworks, Natick, MA).

Results and Discussion

A GC- MS method was developed that could separate the components of four different accelerants in 15 minutes. Figure 1 shows a comparison of the analytical standards for unweathered gasoline (1A), kerosene (1B), diesel (1C) and mineral spirits (1D). From these figures, it is immediately apparent that there are differences in the retention profiles for these accelerants. A comparison of some of the prominent peaks in each chromatogram also draws attention to the differences between the accelerants. For example, the gasoline chromatogram shows a prominent peak (labeled **1** in Figure 1) for toluene (methylbenzene) at 3.9 min. This peak is absent in the chromatograms of the other accelerants. There is also a group of three peaks (labeled **2** in Figure 2) that correspond to *o*-, *m*-, and *p*-xylene (dimethylbenze) around five minutes. All of the other prominent peaks in gasoline correspond to substituted alkylbenzenes. Diesel fuel shows a pattern of evenly spaced peaks that correspond to a homologous series of alkanes starting with dodecane (C_{12}). There are significantly fewer aromatic compounds that can be identified in diesel fuel as compared to gasoline. Kerosene shows a similar pattern but with fewer of the heavier (later eluting) compounds.

Figure 2 shows a comparison between the standard gasoline purchased from Restek (2A) and the gasoline purchased from the local gas station (87 octane, 2B). The circled areas show where the toluene peak and the xylene group line up in the two chromatograms. This figure illustrates the differences between different sources of gasoline. There are more peaks in the early part of the chromatogram from the 87 octane gasoline, most likely from additives used at the refinery. How-

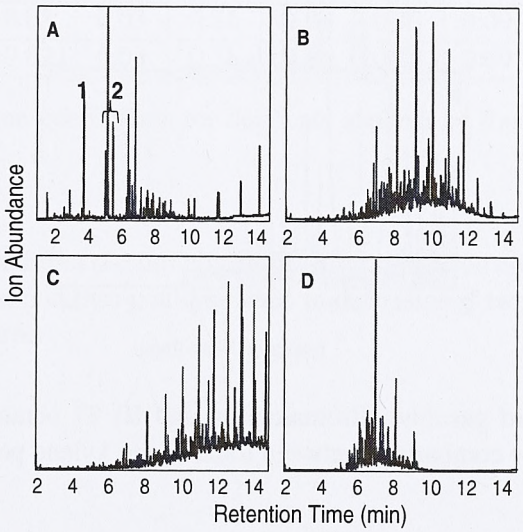

Figure 1: Comparison of four different accelerant standards. A) unweathered gasoline; B) kerosene; C) diesel; D) mineral spirits. Peaks 1 and 2 in 1A correspond to toluene and *o*-, *m*-, and *p*-xylene, respectively.

ever, the toluene and xylene peaks can still be used to distinguish this accelerant from diesel or kerosene.

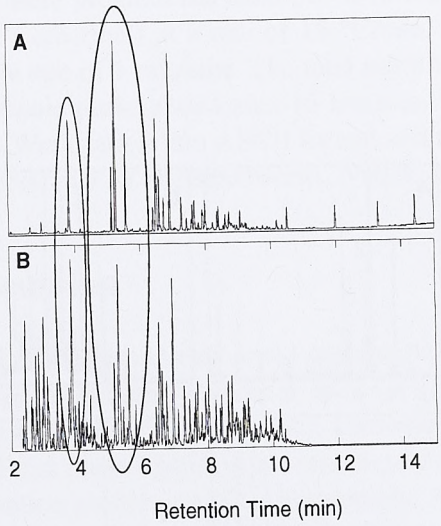

Figure 2: Standard gasoline chromatogram and B) 87 octane Valero gasoline. Circled areas show comparison between toluene and xylene peaks

The goal of this research is to develop methods to mathematically compare a large set of data to identify accelerants based on their chromatographic and mass spectral fingerprints. Our initial results indicate that correlation coefficients can be used as a starting point to compare chromatographic data. Table 1 shows the correlation coefficients calculated for a set of data with duplicate measurements of each type of accelerant. The correlation coefficients were calculated for the chromatographic data only; no mass spectral data were used for this particular experiment. A correlation coefficient very close to one indicates that two samples are very similar (two identical samples will have a correlation coefficient equal to one). The results shown in this table indicate that duplicate samples can be identified by their correlation coefficient. For example, the two gasoline samples are highly correlated, while the gasoline samples and the kerosene samples are

	G1	G2	K1	K2	MS1	MS2	D1	D2
Gasoline 1	1							
Gasoline 2	0.83	1						
Kerosene 1	-0.14	-0.12	1					
Kerosene 2	-0.13	-0.12	0.96	1				
Mineral Sp. 1	0.29	0.41	-0.31	-0.33	1			
Mineral Sp. 2	0.25	0.36	-0.01	-0.03	0.89	1		
Diesel 1	0.03	0.03	0.16	0.26	0.13	0.09	1	
Diesel 2	0.02	0.03	0.38	0.31	0.10	0.09	0.52	1

Table 1: Correlation coefficients for duplicate analysis of four different accelerants.

negatively correlated. For dissimilar samples, the correlation coefficients are close to zero or negative, and thus could be used to determine if two accelerants came from the same source.

Conclusions

This work clearly demonstrates that the different chromatographic patterns generated with a fast GC-MS method can be used to identify accelerant samples. Future experiments will include the analysis of burned fabric and carpet samples and development of extraction methods for removing accelerant residues. A weathering study will also be conducted to determine if the weathering pattern for gasoline can be predicted and used to identify weathered samples. The chromatograms generated from the burned samples, the weathered samples, and the original accelerant will be compared using chemometric methods. The methods of PCA, soft independent modeling (SIMCA), and HCA will be used to compare samples and identify patterns. Finally, the developed methods will be applied to other accelerants such as diesel and kerosene.

Acknowledgements

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Student Biography

Currently, Boone Prentice is a senior attending Longwood University. He is a four-year starter and two-year captain on the varsity men's soccer team, as well as a member of the Honors Program and the Citizen Scholar Program. Additionally, he is the treasurer of both the Student Athlete Advisory Committee and the Chemistry Club. His future plans are to attend graduate school next year in pursuit of a doctorate in analytical chemistry.

Faculty Biography

Dr. Sarah Porter is in her first full year of teaching at Longwood. She holds a Ph.D. in Analytical Chemistry from VCU, a Master's degree in Criminal Justice from VCU, and a B.S. in Chemistry from the University of Virginia. Prior to coming to Longwood, she held a position as a breath alcohol instructor at the Virginia Department of Forensic Science and worked as a bench chemist for Wyeth Consumer Healthcare. Dr. Porter is currently teaching freshman chemistry and instrumental analysis.

Dr. Melissa Rhoten has been teaching chemistry at Longwood since 2000 and has served as the chair of the Chemistry and Physics Department since 2006. She holds a Ph.D. in Analytical Chemistry from VCU, and a B.S. in Chemistry from James Madison University. She has received several awards during her time at Longwood, including a CHI commendation, an LU Citizen Leader Award, and the Maria Bristow Starke Faculty Excellence Award. Dr. Rhoten is currently teaching freshman chemistry and Inorganic Chemistry.

A Comparison of Image Analysis Methods in cDNA Microarrays

Ashley M. Swandby
Faculty Mentors: Dr. M. Leigh Lunsford
Department of Mathematics and Computer Science
Dr. Consuelo Alvarez
Department of Biological and Environmental Sciences

Abstract

As biologists generate enormous data sets using DNA Microarray technology, statistics allow for this data to be properly analyzed and for meaningful results to be obtained from the experiments. The importance of statistics can be observed in many of the steps in the microarray experiment, including image analysis, normalization of data, expression quantification, estimation, testing, clustering and prediction. In the early process of image analysis, data is quantified from image files of microarrays produced in the laboratory. The method of image analysis used by the experimenter may be a source of variation that could affect downstream analysis and consequently experimental results. In this paper, two different image processing programs are used to investigate the variation observed and the potential impact on experimental results.

Introduction and Background

DNA Microarrays allow researchers to measure the impact of treatments on either an entire genome or a large subset of a genome instead of only comparing a few genes at a time. The ability to observe overall patterns in the genome from experimental treatments also provides information on which genes should be studied

further under a specific treatment, especially in determining the effectiveness of disease treatments [2].

On a DNA microarray, thousands of spots are printed, each with a small amount of genetic material corresponding to a specific gene in an organism's genome. When a cDNA sample is applied, or hybridized, to a microarray, the genes present in the sample bind to their complementary sequences spotted on the array. Two samples, a treatment and control, are mixed and hybridized to a microarray. The two samples are distinguished by labeling them with fluorescent dyes of different colors, typically red and green. The hybridized microarray is then scanned by an optical scanner that creates two image files, one for each color used. It is assumed that the intensity level of the pixels that comprise the spot location of a particular gene are an indicator of the amount of cDNA that has adhered to that spot and hence measures the strength of the gene's expression in the sample. Gene expression is quantified through the use of image processing software which produces a file consisting of numerical values indicating the amount of genetic material present for each gene for each sample. Thus the DNA microarray allows for the observation of differences in gene expression between the control and experimental samples for all or a large portion of the genes in the genome.

Image processing of the image files produced by the optical scanner includes locating the spots on the microarray for each gene (called gridding) and determining which pixels in that spot represent genetic material (called segmentation). Gene expression is quantified by assigning a numerical value using the pixel intensities which grid (determining 110 spots or genes) superimposed on a composite image file (i.e. red and green images composed).

Methods

In the Biological and Environmental Science department at Longwood University, DNA Microarray experiments were conducted using standard methods of RNA extraction and cDNA preparation and hybridization. *Sacharomyces cerevisiae* yeast cells were treated with ultraviolet radiation (UV) (254/365nm wavelength). A control sample of yeast was not exposed to UV radiation. The control sample was labeled with red fluorescent dye and the treatment sample was labeled

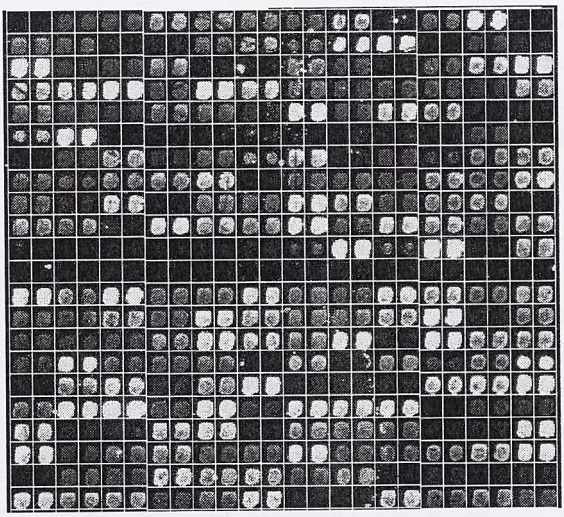

Figure 1: Sample TIFF output from Microarray

with green fluorescent dye. The two samples were then mixed and hybridized to the microarray and the resulting array was scanned. For this experiment, three microarrays were used. Each microarray contained four copies of the approximately 6,000 genes in the yeast genome resulting in approximately 24,000 spots on the microarray. Thus for each gene, we obtained 12 observations, four from each microarray, of both the control sample and the experimental sample. Image analysis of the three microarrays was performed with two different image processing programs: MAGIC Tool (Version 1.4[3]) and SPOT (Version 2.0 [4])

In MAGIC Tool gridding is performed manually by the user to partition each gene into its own square. The program then places a circle of fixed width radius as indicated by the user in the middle of each square. We used a radius of seven pixels. The program then quantifies the amount of genetic material present in that spot by either summing or averaging the total intensities of the pixels in the circle. In our analysis we averaged the pixels within the circle.

In SPOT gridding and segmentation are achieved deterministically via an al-

gorithm. The user may provide some input to guide the placement of the grid and the algorithm may be iterated several times in order to produce the best placement of the grid. Within each square of the grid partitioned for an individual gene, SPOT ranks the intensity levels of the pixels in the square. SPOT uses these ranks along with a circle of a specified radius r to calculate foreground and background. We used the default setting for r. If a pixel is inside the circle and in the highest $x\%$ of the pixels, it is considered to contain genetic material for that spot. Our analysis used the default setting of 30%. The program then quantifies the amount of genetic material present in that spot by averaging the intensities of those pixels identified.

By selecting only the highest-intensity pixels for the foreground, SPOT accounts for genes that do not adhere to the microarray in a perfect circle. In some cases, the liquid solution that contains the samples hybridized on the array pools to the outside of the spot or forms a crescent shape. There are several examples of non-circular spots in Figure 1. When the amount of genetic material present is quantified by averaging using pixels in these "blank" areas, the overall gene intensity is diluted. Thus the segmentation of SPOT is distinctly different than in MAGIC Tool.

Calculations and Results

In order to reduce our computations, we used standard filtering techniques [1] to remove genes that were not present, i.e. those with low intensity levels, to obtain a subset of 1631 genes from the genome. For the remaining genes we computed the gene expression ratio.

$$ExpressionRatio = \log_2 \frac{RedIntensity(experiment)}{GreenIntensity(control)} \quad (1)$$

This ratio is used to understand the relative change of gene expression between the control and experimental samples. Genes that change expression due to the treatment will have large positive or large negative expression ratios while genes that have little or no change in expression will have expression ratios near zero. We calculated the gene expression ratios for the three microarrays using the

intensities computed from both image analysis programs. For each microarray, we then obtained an average gene expression ratio for each gene by averaging the gene expression ratios of the four replicates of the gene on the array. Next we computed several measures to determine the similarity of the output from the two image processing programs and investigated if there was any effect on the detection of genes that had changed expression due to the UV treatment.

First we used Spearman's correlation coefficient [1] to measure the similarity of the average expression ratios computed by MAGIC Tool and SPOT. For each microarray, the coefficient measures monotone association between the expression ratios found for the genes using the output from the programs. The coefficient is given by

$$\rho_s = \frac{12\sum_{i=1}^{n} R_{iM} - \frac{1}{2}(n+1)R_{iS} - \frac{1}{2}(n+1)}{n(n^2-1)} \tag{2}$$

where n is the number of genes and R_{ic} is the rank of the i^{th} gene on the array processed with either MAGIC Tool ($c = m$) or SPOT ($c = s$). This is a nonparametric version of Pearson's linear correlation coefficient using ranks instead of data values. Table 1 shows our results.

Microarray	Spearman's Correlation Coefficient
UV1	0.822
UV2	0.692
UV3	0.844

Table 1: Spearman's Correlation Coefficient

Our next measure of similarity, the concordance correlation coefficient quantifies the amount of agreement between the actual numerical values of the expression ratios. For each microarray we computed this value by

$$\rho_c = \frac{2s_{12}}{s_1^2 + s_2^2 + (\bar{Y}_1 + \bar{Y}_2)^2} \tag{3}$$

where $\bar{Y}_c$ and s_c^2 are the mean and variance, respectively, of the average expression ratios of the genes on the microarray processed with MAGIC Tool ($c = 1$) or SPOT ($c = 2$), and $S_1 2$ isthe covariance. Table 2 gives our results.

Microarray	Concordance Correlation Coefficient
UV1	0.753194
UV2	0.533125
UV3	0.741898

Table 2: Concordance Correlation Coefficient

For both coefficients, a value of 1 corresponds to perfect correlation. As expected, the results in Tables 1 and 2 indicate similarity in the expression ratios computed for the 1631 genes using the two programs. However, we want to determine the impact of any differences for identifying those genes that have been most affected by the treatment, i.e. the genes with high or low expression ratios. To do this we will examine the "extreme" genes (i.e. those with expression ratios in the highest 5% and lowest 5%) determined for each microarray using the MAGIC Tool and SPOT programs. In Table 3 we see the number of genes in common (i.e. matches) for each group for each microarray.

Microarray	Highest 5% (matches/ non-Matches)	Percent Matches	Lowest 5% (matches/ non-Matches)	Percent Matches
UV1	48/37	56.5	57/28	67.1
UV2	44/41	51.8	40/45	47.1
UV3	78/7	91.8	39/46	45.9

Table 3: Percent Matches of Extreme Genes

In the above computations we found extreme genes by using the average ex-

pression ratio determined by the four replicates of each gene on each microarray. We also computed another statistic by dividing the average of the replicates of each gene on each microarray by the standard deviation of those replicates. This number is the inverse of the coefficient of variation (ICV). By dividing by the standard deviation, genes with less variation among the four replicates on a microarray will have higher ICV values than genes with the same mean expression level but with more variation. Thus a gene with a high or low expression ratio that is consistent among all four replicates on the microarray is more likely to be included among the extreme genes. Table 4 gives the number of genes in common for each group for each microarray.

Microarray	Highest 5% (matches/ non-Matches)	Percent Matches	lowest 5% (matches/ non-Matches)	Percent Matches
UV1	55/30	64.7	52/33	61.2
UV2	40/45	47.1	47/38	55.3
UV3	42/43	49.4	42/43	49.4

Table 4: Percent Matches of Extreme Genes using the ICV

Conclusions

With the exception of the highest 5% of expression ratios on UV3 in Table 3, we observe substantial disagreement between the two programs' identification of extreme genes. Since the goal of the researcher is to determine genes that have been affected by treatment, our results indicate the potential impact of the choice of image processing software on experimental results.

Clearly there is further work we could perform to assess the impact of image analysis on experimental results. We suggest future work to include performing our analysis on image files from a published DNA microarray experiment and

comparing the extreme genes determined. We also note that we have not examined the extreme genes determined by our methods in terms of biological function.

Acknowledgements

The author and her mentors would like to thank the Genome Consortium for Active Teaching (GCAT) from whom they have been trained and supplied with scanning services and low cost materials (including the freely available MAGIC Tool software) for DNA microarray research.

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Student Biography

Ashley M Swandby received a Bachelor's of Science degree in mathematics from Longwood University in December of 2007. Along with research in microarrays that allowed for collaboration between mathematics and biology, she participated in a summer Research Experience for Undergraduates (REU) at Miami University in Ohio. There, she completed research in Multivariate Statistics to analyze

health data obtained from the Centers for Disease Control. Currently she teaches mathematics at an all-girls high school in Virginia. She plans to pursue graduate studies in Statistics at NC State this fall.

Faculty Biography

M. Leigh Lunsford is an associate professor of mathematics at Longwood University in Farmville, VA. She earned a BS in mathematics from Mississippi State University in 1985 and a PhD in applied mathematics from the University of Alabama System (Huntsville) in 1995. Her research interests are diverse including assessment of student understanding of mathematics and data analysis of DNA microarrays. In her spare time, she enjoys cooking (and eating!) gourmet food, gardening, and spending time with her mathematician husband and two cats.

Consuelo J. Alvarez is an assistant professor of Biochemistry at Longwood University in Farmville, VA. She earned a BS and a Doctorate in Biochemistry, Clinical Laboratory and Pharmacy from the Universidad Central in Quito, Ecuador from 1981-1988. She also earned a MS and a PhD in Biochemistry, Genetics and Molecular Biology from the University of Illinois (Urbana) from 1990-1996. Her research interests are diverse including Detection of Genetically Modified Organisms, Protein Chemistry, and DNA microarray experiments. Consuelo actively supports golf, basketball and soccer, and enjoys sharing her knowledge of Spanish.

4 The Social Sciences

Perceived Sexual Activity of Short and Long-Term Relationships

Victoria Morgan and Katie Williamson
Faculty Mentor: Dr. Stephanie Buchert
Department of Psychology

Abstract

A sample of 75 Longwood University students read a brief scenario about a dating couple and answered a Likert scale questionnaire about their views on the sexual activity of the couple. Participants received 1 of 4 time periods for the length of the couple's relationship. The time periods were 3 months, 6 months, 12 months, and 24 months. We predicted that the participants who received the 24 months time period would most likely perceive the couple as more sexually active than the other groups. A Three-way Repeated Measures analysis of variance (ANOVA) revealed that all of the participants who received 24 months as the couple's relationship length agreed the same in regard to the question, *I think this couple has been in a long enough relationship to have sex.* Overall, we found that the sexually active participants were more likely to agree that it is acceptable for the couple to engage in sexual activity.

Introduction

Past researchers have investigated many different factors regarding relationships. Moore, McCabe, and Brink[2] examined how intimacy and relationship adjustments affect each other in various types of relationships. These types of relationships included dating, cohabiting, and married couples. Moore et al. defined intimacy as the couple's communication, engagement, and friendship and also

defined the relationship adjustments as the couple's satisfaction, consensus, cohesion, and expression of affection. Whether married couples are happier than cohabiting couples was the topic of interest to the researchers. Eighty-seven couples agreed to participate in the study by answering a questionnaire independently of one another in each relationship. Moore et al. reported that the cohabiting couples had a higher level of relationship satisfaction than the other two groups. The researchers found differences between the answers of men and women in the dating relationships. Men reported higher levels of cohesion, satisfaction, and engagement and women reported higher levels of expression of affection and consensus in their relationship [2] . Most importantly, the researchers found that the married couples had the highest agreement on all the factors of their relationship except communication.

Maxwell, Sack, Frary, and Keller [1] were interested in contraceptive behavior of college students regarding their dating patterns, emotional involvement, type of birth control used, number of sexual partners, and reasons for not using birth control. Two-hundred-twenty-two college students participated by completing a questionnaire about the five factors and their dating behavior during high school and college. Maxwell et al. found that 61% of all the participants reported always using contraceptives during intercourse and 4% of the participants reported never using contraceptives. The researchers also found that women reported a higher level of emotional involvement than men. If the participant reported a high level of emotional involvement, then they also reported that they were more likely to use contraception due to the importance of the relationship [1].

Another interesting study performed by Rostosky, Welsch, Kawaguchi, and Galliher[3] examined the relationship between commitment and the sexual activity of adolescent dating couples. Most importantly, the relationship length, commitment, and sexual behaviors of the couple were addressed to show whether they relate to each other. Sixty high school and college couples who reported dating for at least four weeks participated. Rostosky et al. asked participants to complete the Dimensions of Commitment Inventory (DCI) and the Sexual Behaviors Inventory. The DCI contained the Commitment to Partner, Commitment to Relationship, and Feelings of Entrapment subscales and the Sexual Behaviors Inventory contained questions regarding pregnancy, sexually transmitted diseases, dating behavior, and contraceptive use [3].

Rostosky et al. found that male participants perceived the length of the relationship to be positively related to the commitment to their partner and to their relationship. The researchers also found that the female participants perceived the length of the relationship to be positively related to the commitment to their relationship and the feelings of entrapment in their relationship . The six sexual behaviors that the researchers investigated in order to compare to the commitment of the couple were holding hands, kissing, fondling with clothes on, fondling without clothes, oral sex, and sexual intercourse. Hand holding and kissing were found to be more important to the commitment of the couple's relationship than fondling and intercourse. In conclusion, Rostosky found that the results suggest that the commitment in an adolescent dating relationship is just as significant as it may be in an adult married relationship, with only the meaning of the commitment being different.

After consideration of the literature about the factors regarding relationships, we have decided to study how participants perceive the sexual activity of a couple based on the couple's relationship longevity. We predicted that the participants who received the longest relationship length would perceive the couple as being the most sexually active. We predicted this because commitment seems to be related to the longevity of a relationship, which means the longer a couple is together, the more likely they are to be perceived as sexually active.

Method

Participants

Seventy-five Longwood University students between the ages of 17 and 37 years (18 men and 60 women, mean age = 19.96, *SD* = 2.98) participated in this study. Participants consisted of 36 freshmen, 14 sophomores, 15 juniors, 9 seniors, and 1 other. Participants were volunteer psychology students who signed up through an electronic system and received extra credit for participating.

Materials

The materials included a brief written description about a couple's relationship with one of four relationship lengths for each group: 3 months, 6 months, 12 months, and 24 months (see Appendix A). Other materials included a brief 5-point Likert scale questionnaire, with one being *strongly disagree* and five being *strongly agree*. The questionnaire consisted of questions regarding the sexual activity of the couple (see Appendix B).

Procedure

Participants read a brief scenario about a dating couple and completed a questionnaire about the couple based on the length of time given. When finished, participants placed their questionnaire in an envelope themselves and then the researchers debriefed the participants about the true nature of the study.

Results

We performed a 3-Way Repeated Measures analysis of variance (ANOVA) on all the target questions. This revealed that the participants who reported being sexually active agreed more that the couple had been in a long enough relationship to have sex (question 9) than the participants who reported not being sexually active, $F(1,60) = 8.287$, $p < .05$ (see Figure 1).

In regards to the same question, we also found an interaction between the sexually active and non-sexually active participants. All the participants who received 24 months as the couple's relationship length agreed equally about the couple being in a long enough relationship to have sex, $F(3,60) = 2.803$, $p < .05$ (see Figure 2). Also referring to Figure 2, the sexually active participants who received 3 months and 12 months as the couple's relationship length agreed more with question 9 than the sexually active participants who received 6 months and 24 months as the couple's relationship length. Opposite results were found with the non-sexually active participants.

The ANOVA also revealed that participants who received 3 months as the couple's relationship length agreed the most that the couple should wait to have

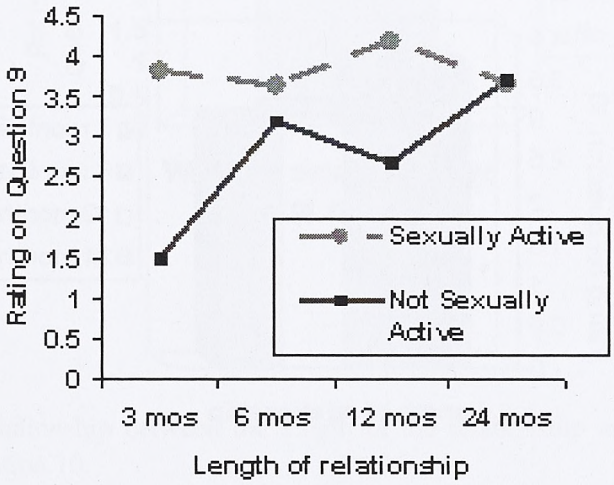

Figure 1: Relationship between sexually active participants and their views on question 9

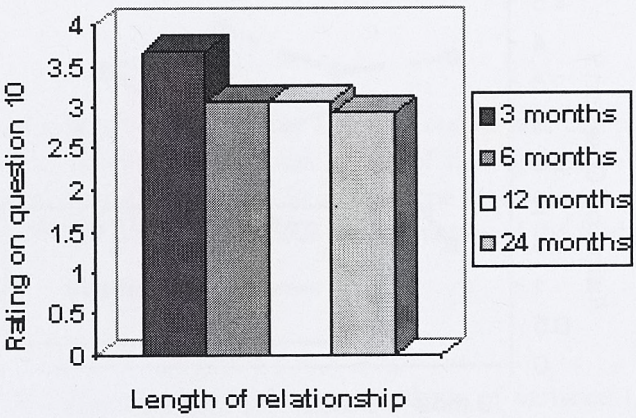

Figure 2: Interaction for Question 9

sex (question 10), $F(3,60) = 3.508$, $p < .05$ (see Figure 3).

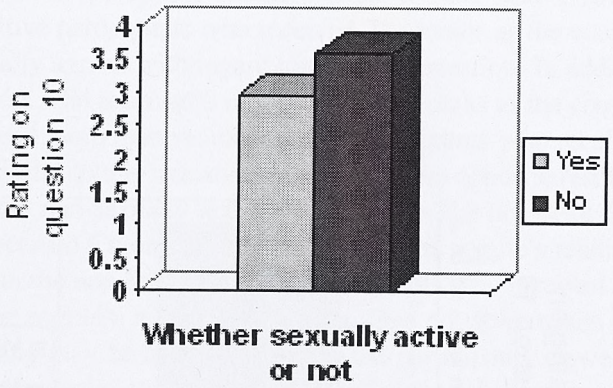

Figure 3: Relationship between the length of the relationship and participants views on question 10.

Lastly, when referring to the same question, we found that the non-sexually active participants agreed significantly that the couple should wait to have sex, $F(1,60) = 8.906$, $p < .05$ (see Figure 4).

Discussion

Based on the results, our hypothesis that the participants who received the longest relationship length would perceive the couple as being the most sexually active was not supported. However, many interesting results were found. In regards to the question, *I think this couple has been in a long enough relationship to have sex*, participants who reported being sexually active agreed more than participants

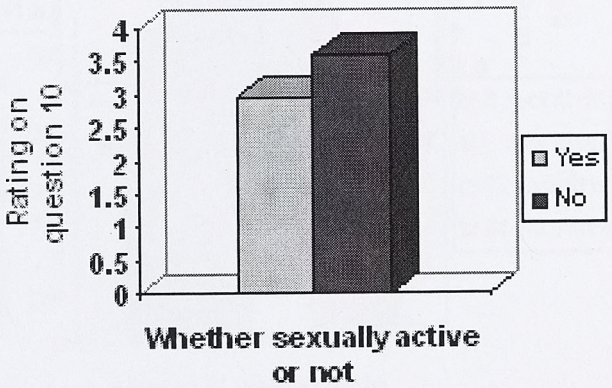

Figure 4: Relationship between participant sexual activity and their view on question 10.

who reported never being sexually active. We believe we found this result because participants who engage in sexual activity themselves may be more likely to agree that it is acceptable for another couple to have sex. Both sexually and non-sexually active participants who received 24 months as the couple's relationship length equally agreed with regard to the same question. In addition, sexually active participants who received 3 months and 12 months as the couple's relationship length agreed more than sexually active participants who received 6 months and 24 months as the couple's relationship length. The opposite results were found with regard to the non-sexually active participants. The non-sexually active participants who received 6 months and 24 months as the couple's relationship length agreed more than the non-sexually active participants who received 3 months and 12 months as the couple's relationship length. One possible reason for this counterintuitive finding may be because many of the participants viewed all the time periods as long-term relationships. It was intended for the short-term relationships to be 3 months and 6 months and the long-term relationships to be 12 months and 24 months.

In regards to the question, *I think this couple should wait to have sex*, participants who received 3 months as the couple's relationship length agreed the most. Even though many participants who received 3 months may have found it acceptable that the couple engages in sexual activity, they also may believe that they should wait longer to have sex. In addition to this question, it was found that the non-sexually active participants agreed more than the sexually active participants. This may have been found because the non-sexually active participants are waiting to have sex themselves, so they would be more likely to think abstinence is more acceptable for other couples.

One limitation to this study was that the majority of the participants were female. In the future, researchers should try to receive a more representative sample of the general population. We believe with more male participants the results may show a higher acceptance of sexual activity of the couple. Another limitation was the lengths of the relationship because participants viewed the lengths of the relationship differently from what was intended. In the future, it is suggested that the researchers should have the short-term relationship be less than 1 month and the long-term relationship be greater than 5 years. This should help the participants distinguish between the short and long time periods. Overall, the results

suggest that many factors influence a person's views on relationships including the longevity of a relationship, the person's own sexual activity, and their view of whether the relationship is short or long-term.

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Appendix A

Jack and Jill are a Caucasian heterosexual couple. They are both 20 years of age and they have been dating for (three months, six months, twelve months, or twenty-four months). Jack and Jill are not engaged or married. They enjoy watching movies at the local movie theater. Their favorite pastime is spending time together at the local beach and eating at their favorite seafood restaurant.

Appendix B

Please answer the following questions as honestly as possible. Circle the choice that best fits your answer.

Answer the following questions using the following scale:

1 - (Strongly Disagree)
2 - (Somewhat Disagree)
3 - (Neutral)
4 - (Somewhat Agree)
5 - (Strongly Agree)

1. I perceive this couple to be happy.

1 2 3 4 5

2. Do you think this couple is in a short term or long term relationship? (Circle one) i

Short-term Long-term

3. I enjoy spending time at the beach.

1 2 3 4 5

4. I think this couple has the potential to be married in the future.

1 2 3 4 5

5. I think this couple engages in sexual activity (intercourse).

1 2 3 4 5

6. Do you currently have a boyfriend/girlfriend?

Yes No

7. Have you EVER been sexually active (engaged in intercourse)? Yes No

8. I think this couple has a healthy relationship.

1 2 3 4 5

9. I think this couple has been in a long enough relationship to have sex.

1 2 3 4 5

10. I think this couple should wait to have sex.

1 2 3 4 5

Gender (Circle one):
Male Female

Age: _____

Class Year (Circle one):
Freshman Sophomore Junior Senior

Student Biography

Victoria Morgan

Victoria Morgan was born and raised in Virginia Beach, Virginia where she earned her high school diploma at Kempsville High School in 2004. She is currently a Longwood University Senior earning a Bachelor's of Science Degree in Psychol-

ogy with a minor in Sociology. After graduation in May 2008, she hopes to further her education by earning her Master's Degree in Community or School Counseling.

Katie Williamson

Katie Williamson was born and raised in Fauquier County, Virginia. She received her high school diploma at Liberty High School in 2004. Currently she is a Longwood University Senior earning a Bachelor's of Science Degree in Psychology with a minor in Art. After graduation in May 2008, she plans to begin her career and later receive her Master's Degree in Art Therapy.

Faculty Biography

Dr. Stephanie Buchert has been an Assistant Professor of Psychology at Longwood University since 2004. She earned her Ph.D. in Experimental Psychology from Kent State University and holds B.A.'s in Psychology and Anthropology from Bloomsburg University. Her research interests include cognitive development – specifically language issues such as language development and bilingualism.

Elderly Male Communication

Kristine G. Bender
Faculty Mentor: Dr. Pamela Tracy
Department of Communications Studies

Abstract

While reviewing the vast amounts of communication studies research, an astonishing void exists. Study and analysis of older male communication is absent from extensive consideration. This fact motivates me to take a closer academic look at the subtle, interesting methods behind older male nonverbal and verbal communication. This comprehensive investigation begins by examining current work from gerontology, history, and sociology. Academic articles discussing older males and their behavioral patterns, today and earlier in their lives, help me navigate the next step of my own research process. After summarizing such scholastic work, I go into the research field armed with questions and hypotheses. Field data focuses on observations of the communicative process between older men, and then the communicative process between younger men. With scholarly and field research complete, I conduct one-on-one interviews with older men. These questionnaire responses help formulate conclusions and identify any reoccurring trends within my subject of research. The combination of interviews, field observations, and previous scholastic work contribute to my exciting, and sometimes surprising, discoveries. Older men communicate in distinctive, intelligent ways that should earn a well-deserved place in communication studies research.

Introduction

Gendered communication is an extremely well-researched area in the contemporary academic world. Scholars investigate fascinating aspects of female and

male interpersonal communication, which both question and analyze existing social norms. Despite the intellectually insightful work of published scholars, the study of older and elderly male-to-male communication is noticeably absent from expansive research. As an enthusiastic communication researcher, I desire more knowledge concerning this gender group in order to explain their distinction from younger male-to-male communication. Older men, specifically 60-70 years of age, talk and socially gather in ways which deserve detailed analytical attention. Research and data analysis provide extremely valuable insight into this underrepresented gender faction. Through the use of article research, field observations, and personal interviews, I gather sufficient data for my investigative purposes. This detailed analysis begins with basic scholarly research from topical areas within the overall subject in question. Academic resources from history, gerontology, and sociology all apply while inquiring about older male communication trends. My first notable academic source comes from a historical scholar.

Older men incorporate a unique up-bringing, set of beliefs, and pedigree, originating from their up-bringing, as they continue to interact within their gender today. In his text, McBee[4] acts as a social historian as he investigates the male culture during a specific social climate in history [3]. This particular article begins by explaining the basic concept behind all-male clubs, saloons, and poolrooms. Men at these clubs often form group opinions, attitudes, and culture after engaging in verbal discourse with each other. Clubs were predictably organized based on socioeconomic class. Beyond the essential principles of male social clubs, McBee examines the societal implications behind such organizations. He discusses the "typical man" which emerges from this particular era. He is strong, admired by men, and loved by women. This article presents the interesting term "heterosociety," which refers to the culture of heterosexual male friendships characterized by loyalty and invested time. Another important scholarly source comes from a sociological perspective. This author utilizes wit and honesty while defending the value of male friendship communication.

Max Davidson's[1] newspaper feature is a quality defense for adult heterosexual male friends. This publication is a humorous, yet extremely thought provoking piece denouncing a commonly held position: women are better friends to each other than men. The short text cites personal and general examples of steadfast, significant male friends and the characteristics that make connections strong.

Davidson concludes his brief feature by brilliantly comparing interpersonal male interaction with soldiers at war, defending and helping one another. Due to the gender specificity of the early military, this association rings true and sums up the persuasive message quite successfully. Many men between the ages of 60 and 70 grew up and socially developed in a tense national climate, while many also experienced direct involvement in military struggles. This reality serves as a crucial factor when unraveling males' communication identity.

A final piece of scholarly research presents age as an issue. John Knodel and Beth Ofstedal's article[2] is an extensive examination of aging men and their place in an ever-changing social landscape. Providing ample graphs and statistics with a sociologically driven text, these scholars allow the reader to observe a neglected gender group. Their notes and commentary discuss the neglect suffered by elderly men, and behaviors resulting from continued disregard. Knodel's and Ofstedal's article is intelligently organized in sub-topic sections such as 'theoretical perspectives on gender and aging' and 'social and economic well-being'. Numerical research explains America's population development, and outlines challenges faced by elderly men as they carve out an identity in a rapidly changing world. Looking at age as presented in this article identifies the influence it asserts over communication styles. The communication exchange between elderly peoples, especially men, is often muffled by the whirling, technologically savvy world of modern communication.

Older men and the communication between them complicates further when factoring in age-related disabilities and diseases. Due to the rising quality of health care, human beings are living longer. This population trend sets the stage for an increased amount of elderly illnesses, hindering communication capabilities [3]. Large amounts of research reflect studies on physical limitations on older males' verbal discourse. While analyzing common communication characteristics and tendencies among older men, research must consider physical and possibly mental restraints, often resulting in unusual communicative habits.

Methods, Discussions, and Findings

The second phase of investigation into older male communication sent me to the field. With the contributing work from article authors, I entered the field ready to compare scholarship with real-world occurrences. I observed male-male interaction in various settings, representing two focused age groups. I first observed male-male interaction from the ages of 18 to 22 at two locations. I went to the Tiger Inn, a social gathering place at Hampden-Sydney College. I also observed male-male communication at a Longwood University Army ROTC fundraiser at the restaurant/bar Wingshak.

Observed cultures of young men reveal interesting trends while students communicate with each other. Both at the Tiger Inn and Wingshak, men communicate in large groups of seven or eight, creating busy communication patterns. At both field sites, men tend to use volume and physical motions in order to receive communication dominance. Humor, jokes, and laughter remain a very prevalent characteristic within heterosexual male interaction. More males enter into communication with one another if the discourse is light and comical. All young men use activities in order to spend time with other men. Both sites offer competitive sports such as pool, dart-shooting, and video games in order for men to tease, trash-talk, and encourage one another. Young men communicate with a variety of other males varying in race, dress, and physical appearance. These locations for male-male interaction offer a comparative set of data complimenting the following observations of older male communication.

To assess the more important research population, older males, I visited Huddle House and St. Theresa's Catholic Church to observe elderly men in their natural habitat. Huddle House is a 24-hour establishment attracting elderly men for breakfast. St. Theresa's Catholic Church served as a second place for field research. The Catholic Church includes an all-male organization called the Knights of Columbus. I observed this group of individuals as they congregated after Sunday Mass. At both locations, I primarily focused on men appearing to represent the 60-70 age bracket.

At both Huddle House and St. Theresa's, older males ask each other questions about family, friends, and jobs to initiate verbal exchange. Men use this method of question and answer discussion in order to show interest in fellow males. In-

dividuals within both settings maintain a more serious tone for communication with the occasional humorous anecdote or pun. These elderly males enjoyed a quiet, respectful verbal discourse with small communication groups of three or four men. Elderly males utilize the head nod or handshake as a communication courtesy. These physical formalities signal the desire to enter or exit communication with each other. While verbally communicating, older men include moments of thoughtful silence with no words exchanged. At the Huddle House site, I observed several distinctive communication characteristics. While men communicate during breakfast, they maintain little eye contact and use more nonverbal forms to send a message. Men in the Knights of Columbus communicate in a more formal, elevated style with heavier content. The Knights also seem to associate with their own socioeconomic class.

After field research, I eagerly conducted one-on-one interviews, asking males five questions about their heterosexual male communication practices. I interviewed five males from the age 18-22. All young interviewees respond with very similar answers. The representatives from the 'young adult' age group place great value on male friendships. Almost all respondents value male friendships more than romantic relationships. When I ask interviewees how they commonly communicate with male friends, they unanimously favor face-to-face verbal discourse over any mediums such as the telephone or instant messenger. I then ask each interviewee about their level of disclosure to male friends. All five young males claim to closely monitor amounts of personal disclosure when communicating to other males. Some males allege they disclose personal thoughts, emotions, and worries with a close network of male friends. All interviewees prefer lighter topics of conversation such as sports or movies. Interviewees unanimously choose to spend time or 'hang out' with males in order to communicate the desire for friendship. Responses repeatedly emphasize competitive activities such as sports and video games during communication. A majority of interviews highlight bars and drinking alcohol during male discourse sessions. Males also exchange favors with other males in order to communicate closeness.

With interview data gathered from five younger males, I interviewed men from the ages of 60-70. I used the same five questions and looked for themes and reoccurring answers among five elderly respondents. Overall, these men moderately value their male friendships. They claim to enjoy face-to-face communication

while participating in activities such as sports, watching movies, or going out to eat. Interviewees respond with 'little to moderate amounts' when asked about the amount of personal disclosure to fellow males. All five subjects do not generally share personal worries, feelings, or concerns within heterosexual male relationships. To communicate closeness, these older men respond with 'doing favors' or 'helping with a task' as possible tactics. Men of a more mature age answer interview questions with hesitation, as if they do not understand any importance behind male-to-male communication. With all three research processes complete, I am able to formulate comparisons and conclusions.

Conclusions

Academic literature, field observations, and interview data correlate and overlap when looking for general research themes. With evidence from scholarly research and interview data, I observe subtle socioeconomic parameters in elderly male communication. Due to socialization during a specific time in history, men between the ages of 60-70 tend to interact with men of similar race, family background, and community status. The concept of 'male clubs' presented in McBee's article remains influential as those aged individuals continue to socialize within their class. Observations of elderly men in the field also find them within their strict homogeneous groups. As a result, the more accepting social landscape of contemporary culture, this trend seems to decrease in younger generations of males.

Interview, article, and field data all point to activities as a crucial component for man-to-man communication. Older men enjoy face-to-face communication, and usually desire some kind of activity during 'man time'. This characteristic remains constant in younger generations. By participating in activities, mature men are able to 'make fun' or 'tease' male friends. Interviews and field observations affirm this type of friendly jesting as an important part of verbal discourse. Davidson's war comparisons surface during analysis. Troops of men bonded and communicated during American wars by teasing and challenging one another. This communication inclination stays with elderly veterans of war when they mention 'doing favors' or simply 'spending time' as main forms of closeness. Field

observations show men helping or spending time with each other instead of participating in extensive verbal communication.

Due to age disabilities or limitations, elderly men communicate in smaller, simpler communication groups. Older men also add silence in verbal conversations to mentally catch up with content. Men in the field and those interviewed express a desire for calm, but stimulating verbal conversation. A worsening sense of hearing and vision results in a subdued, discrete culture of verbal discourse between older males. Age explains the sporadic silences during my field observations of elderly male conversations, and the more quieted, respectful nature of discussion at Huddle House and St. Theresa.

Older interviewees tend to value a life partner's feedback in older ages, whereas younger men interviewed speak fondly of frequent male communication. Though elderly men continue to enjoy same gender exchanges, they begin to concentrate interaction toward a spouse or life partner. This decreased value of male interaction affects amounts of disclosure. Older men claim to only moderately disclose personal information, while the younger generation speaks of a more liberal forum of discussion between men. Younger generations live in a world which is more accepting of open communication. Elderly men still abide by the silent, strong masculine image of their youth when avoiding large amounts of disclosure.

Elderly men communicate in discrete, fascinating ways. Society generally ignores this gendered group due to their silent, gentle nature. After researching older men in academia, the field, and then one-on-one, I develop a fascination with their specific communication patterns and practices. Historical influences explain many male communication tendencies, while age and gender specific qualities assert another form of influence over interaction. Older men recognize physical limitations during communication, while still portraying an understated sense of closeness to their heterosexual male friends. Overall, my analysis of male verbal and non-verbal exchange uncovers interesting explanations and enlightening comparisons, creating endless opportunities for future research.

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Student Biography

Kristine Bender is a junior at Longwood University. Within the Communication Studies major, she is concentrating in strategic and organizational communication with a minor in History. She is an enthusiastic campus participant, appearing on the executive boards of Catholic Campus Ministry, Alpha Lambda Delta, and the Communication Studies Club. Recently she also served as a Peer Mentor and received the Class of 1948 Scholarship while participating in the Honors Program

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Faculty Biography

Dr. Pamela Tracy is an Assistant Professor of Communication Studies at Longwood University and Director of Longwood Seminar. Tracy received her B.A. in Communication from the University of Southern Maine. She earned her M.A. in Mass Communication from Bowling Green State University, and then went on to earn her Ph.D. in Communication Studies from Ohio State University. Dr. Tracy has received a long list of awards and recognitions including Who's Who Among Professional Women (2000) and the Professional Development Award from Ohio State University (1996-2001). She is highly respected and beloved by many Longwood University faculty, staff, and students.

5 English

"There's Nothing Like Dancing, After All": Marriage and Gender in the Dance Scenes of Jane Austen's Novels

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Abstract

Dancing in Regency England was a favorite pastime for many, including Jane Austen. Of all the moments in Jane Austen's novels, her dance scenes remain among the most complex and memorable. Scholars largely agree that Austen's dance scenes are a metaphor for marriage; however, I believe they go beyond that simple explanation—not every dance leads to a normalizing convention like marriage but can sometimes lead to confusion and misunderstanding. Austen employs the dance to critique the suitability of men and women as potential spouses through a unique spin on gender roles. On the dance floor, the best partners for marriage combine male and female characteristics. Austen presents a revised code of conduct for both women and men through dance, radically suggesting that androgyny ensures the stability of social conventions like marriage.

Introduction

Of all the moments in Jane Austen's novels, her dance scenes remain among the most complex and memorable. Joan Grigsby writes that the dance scenes in Jane Austen's novels "sparkle through the pages... like candles on a Christmas tree" (qtd. in [4]). Considered individually, these scenes burn in the reader's mind, but they are also structurally essential to Jane Austen's novels as they provide catalysts

for major events, often launching a web of new relationships and intricate plot developments. For example, Mr. Darcy's refusal to dance with Elizabeth Bennett initiates the central conflict of the novel's plot, a dance introduces Catherine Morland to Henry Tilney, and dancing leads Highbury to assume Frank Churchill and Emma Woodhouse will ultimately unite in marriage. In Austen's novels, dancing is more than just two bodies colliding briefly in time to the music, Austen reveals a unique spin on gender roles through the performance of dance, critiquing the suitability of men and women as potential spouses.

The country dances Jane Austen describes reached the apex of popularity in the Regency era. The name "country dance" derives from the French *countre danse*, referring to the format of the dance as opposed to as specific location. The dancers face each other in two rows, one for men and one for women, and the foremost couple leads down the line and the rest follow. The couples make a variety of patterns as they lock arms and join hands [3]. Dances in Regency England could be categorized in one of three groups; some were private events held by families who would invite close friends and neighbors, others were public gatherings to which the entire neighborhood was invited and admitted by invitation—like Bingley's party at Netherfield where Elizabeth first dances with Mr. Darcy—and some were spontaneous, similar to the improvised dance Frank Churchill encourages at the end of a dinner gathering at Mr. and Mrs. Weston's. Usually on these impromptu occasions, an elderly or married woman would take a place at the piano and provide music for the younger couples, as Anne Eliot does at the Musgrove's.

Men and women took balls and dancing very seriously in Regency England. Molly Englehardt asserts that "dance was the single most popular and important recreation among any group of people." Members of the middle and upper classes depended on social events like balls as a means to introduce them to neighbors and other acquaintances. Young, unmarried people especially went to balls with the hopes of finding a future spouse. Deidre Le Faye comments that "modern readers are sometimes puzzled as to why dance scenes have so prominent a place in Jane Austen's novels", however, balls were "the best, and indeed almost the only place where... courtship could flourish" (103). Austen understood the vital importance of the dance floor to men and women; it was a unique space where they could come together in a socially acceptable, monitored atmosphere and have a semi-private encounter with the opposite sex.

Scholars differ slightly in how they view the dance scenes in Jane Austen's novels, and although each of these scholars contributes something distinctly unique to the current conversation of dance in Austen scholarship, they all agree that dance is a metaphor for marriage. Dancing, for these scholars, is the only way for "young people to experiment with the romance plot" (Englehardt) and courtship. Timothy Dow Adams in his article "To Know the Dancer from the Dance: Dance as a Metaphor of Marriage in Four Novels of Jane Austen," writes that the heroines of *Pride and Prejudice*, *Emma*, *Northanger Abbey* and *Mansfield Park* "must judge each of her dancing partners for...compatibility, not just for the dance, but also for possible marriage" (56). Elizabeth Bennett, Emma Woodhouse, Catherine Morland and Fanny Price chose former dance partners as husbands, but what about the other dancing couples who face alternative outcomes?

While Adams, Wilson, Englehardt and Stovel are correct in their assertions that dance is a metaphor for the social mechanism of marriage, they fail to acknowledge the dance floor's failed partnerships. What is it about George Knightley's performance on the dance floor that makes him a more viable candidate for marriage than Frank Churchill and what reveals that Fanny Price is superior to Mary Crawford? Dancing as a performance is best seen through the lens of Judith Butler's gender as performance—the idea that gender is "fabricated by acts, gestures, [and] enactments" coded by society as either masculine or feminine (136). If it is true that gender, biological sex, and orientation of desire is all a performance, I find it interesting that Austen incorporates so many "performances" through dance in her texts. For Butler there is no true gender identity; it is a socially constructed "law" providing the ideals of male and female characteristics [1]. Failure to abide by the "law" disturbs the social system, subjecting those who unsuccessfully perform their correct gender roles to punishment and potentially social sanction. The gender bending in the ballroom reveals Austen's covert constructions of gender beyond the dance floor.

Methods

For my research I have closely read Austen's six main novels, *Sense and Sensibility, Pride and Prejudice, Emma, Mansfield Park, Northanger Abbey* and *Persua-*

sion for examples of dances and dancing, and critically analyzed the different ballroom scenes and how they affect the plot's development. I have also researched the historical context of dancing in Regency England and I have applied current gender theory to the performance aspect of the dance.

Discussion Findings

In this study I explored further the correlation of dancing and the traditional gender roles associated with marriage. In the early nineteenth century, marriage was a stabilizing social convention, that formed the basis of the family, guided laws of inheritance and regulated sexual conduct. On the other hand, dancing could be a disruptive or rebellious force, leading not only to a normalizing structure like marriage, but potentially other liaisons. It is true that in due course, most of Austen's dance partners waltz down the aisle toward matrimony, but in some instances there are other consequences. Take *Sense and Sensibility*'s Marianne Dashwood and Willoughby, for example. Their many nights of intimate dancing do not progress to the wedding chapel, but instead result in a devastating heartache for Marianne. When she finds out Willoughby is marrying Sophia Grey, she even contemplates suicide. Willoughby is no Mr. Darcy or Mr. Knightly; he is not a reluctant dance partner, but is rather an enthusiast. Is the dancing metaphor Austen's social commentary on how dancing with the right partner influences happy marriages and with the wrong partner, broken hearts? I believe it is.

For the purpose of my argument, I have divided Austen's characters into two categories: the "wrong" dance partner and the "right" dance partner and I assert that Austen employs dancing as gender as performance as a tool to judge a partner's suitability for marriage. She presents women who are outspoken and witty; refusing to settle for anything less than what they sanction for themselves like Emma Woodhouse as well as those who are at the other end of the spectrum—the meek, quiet, and proper female like Fanny Price. Although these two women are polar opposites, they are both Austen's idea of the "preferred" partner. Emma Woodhouse and Fanny Price, in their individual ways, possess characteristics associated with masculinity. While her heroines vary vastly, Austen's men are not so diverse. Austen contrasts the "wrong" dance partner, a hedonistic and sexy

rascal to the "right" partner, the upright, stiff gentleman. Unlike Henry Crawford or Frank Churchill, Austen's idea of the "wrong" partner, the decorous gentleman like Edmund Bertram or Mr. Knightley displays a certain softness—a gentle, sentimental side typically associated with women. On Austen's dance floor, characters subvert or maintain traditional conventions of masculinity and femininity. Androgyny is the preferred form of "gender" for Austen. The right partners exhibit characteristics of both men and women and are ultimately the best candidates for marriage.

What makes some partners marriage material and others not? For Austen, how a person performs while dancing is a reflection of his or her gender off the dance floor. The characteristics the wrong partners exhibit on the dance floor that appear to promote their suitability for marriage, paradoxically, deems them inadequate as future husbands or wives. Men and women who are free and open with their emotions and careless in their treatment of others are usually willing dance partners and heartbreakers. Libertines, like Henry Crawford who wants Fanny Price to dance and fall in love with him to encourage another woman, are deceitful and will eventually lead a woman to despair. For instance, Willoughby's charming abilities on the dance floor blind Marianne to his behavior in society. He's squandered his fortune, impregnated a woman out of wedlock, and refuses to accept responsibility for his actions. Selfishness, vanity, hedonism and a disregard for propriety are the stereotypical qualities associated with either men or women that the "wrong" partner possesses. While the wrong partners gender bend on the dance floor, they bend too much so. Frank Churchill gratifies his narcissism – a decidedly feminine attribute, by dancing so much so that he forgets his masculinity. The wrong partners are not balanced in their gender shifting, ultimately making them excellent dance partners, but not suitable for the marriage state.

Ironically, the partners who make good spouses, those who will provide a secure future, are often guarded and reluctant dancers. Austen writes that "every savage can dance" [2], but it takes a real, upstanding, person of good character to suit the realms of the ballroom and society. The right dance partner is attentive in every aspect of his or her life, not just on the dance floor. They are a combination of both masculine and feminine characteristics that ensure their success on and off the dance floor. For example, Mr. Knightley assumes the role of a woman and offers to move to Hartfield and give up his own property for Emma's

happiness and security—a quality that makes him not only a good dance partner but an excellent candidate for marriage. The successful partnerships in terms of marriage are based on distinguishing qualities, such as stability, dominance, and particularly the blending of both female and male stereotypes.

Conclusion

Dancing was a key element in the culture of Regency England. Because of the important role the dance played in the lives of men and women, it only makes sense that Austen would use the dance scenes to say something extremely important. To look at dancing as a metaphor for simply marriage or sex is to overlook Austen's point completely. Looking beyond dancing as a metaphor for marriage and closely analyzing why some partnerships succeed while others fail, I believe my research furthers the understanding of the complexities of Jane Austen's dance scenes. Dancing as performance is Jane Austen's way of revising the marriage market. Her dance scenes reveal the interesting way she viewed marriage and gender; ironically, marriage security derives from the instability of gender roles.

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Student Biography

Niki Swann is currently a senior English major at Longwood University. She is an avid scholar of British literature, particularly the nineteenth century. After graduating, she hopes to continue her education at the graduate level.

Faculty Biography

Esther Godfrey received her doctorate from the University of Tennessee in 2005 and is an Assistant Professor of British Romanticism at Longwood University. She has published articles on gender, aging, and marriage in *SEL*, *Topic*, and *Genders*. Her first book-length study of age disparate marriages, *The January-May Marriage in Nineteenth-Century British Literature*, is forthcoming from Palgrave Macmillan in 2008.

Three poems

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Abstract

The three poems I have selected for this publication serve to demonstrate the unique variety of forms I've discovered this genre to possess to use rhythms and shapes aurally. Poetry, for me, is about sound. I have a musical heritage and have, thankfully, been encouraged by my professors to make use of it in my work as a poet. I believe that meaning is directly linked to sound, to the voices that we inherit, to the rhythms that we learn instinctively.

Artist's Statement

Poetry, for me, is about sound. I have a history studying music, and it has always fascinated me how close to language most melodies seem. A phrase is like a sentence; a cadence is the intonation in a voice. Poetry, too, is one step from what we know to be language; it surrounds something, it sings. I believe that we have a deep need to hear our voices in a musical context, to have ordinary experience expressed in a form that is lasting and beautiful, but also outside of ourselves and holy. For this, I use the music of meters and internal rhyme in order to remake language and elevate experience. My work is often highly lyric because of this, drawing on metaphors and phrases that I see as primarily musical. My work is also highly confessional. I often draw on the family experiences and personal relationships that have shaped my identity as a female, struggling to understand the way in which others have formed me into the person that I am. I have found the unique ability of poetry to ask questions about myself and my experience, to confront

the past as honestly as I am able. My poems are often about the communication distance in sexual relationships or the misunderstanding in family relationships. In my work, I can express the things hardest to communicate in relationships. My poetry attempts to recreate the pieces of my relationships as sister, daughter and lover, and I hope that my own voice will speak to others in similar roles, struggling to maintain the independent core identity as a female. But as a beginning poet, I still experience the molding influence of various authors that I read and love. My work is highly influenced, not only by my love of music, but also by my love of past authors whose voices I admire. I've experimented with various styles including the formal rhyme schemes and diction of Keats and Shelley, and the experimental style of contemporary poets such as Adrienne Rich and Anne Waldman. Their voices have become a part of the way that I express myself, and at Longwood, I have been encouraged to use the forms of those great writers whose voices I feel succeed in speaking to me. Emerson once cited a proverb that I think of as my responsibility, not just to admire work I love, but to learn from it: "He that would bring home the wealth of the Indies, must carry out the wealth of the Indies." My work as a poet has become to carry on the traditions that I love, to stay with the forms that I think succeed. In my creative writing education at Longwood University, I hope to continue to learn from authors who've succeeded, and continue to confront truth in my past in my own voice, and with the music that I love.

Adam and Eve and an Orange Tree

They have watched it many times – the
ripening and the rotting of the fruit, the
bent branch a sore question mark, weighted with
round handfuls of sin. They must have ached to bear
it in the hollows of their mouths.

I have the feeling that we began there, with the
watching and the waiting by the tree, their
beautiful innocent bodies making
love from a primal recipe – the simple alchemy
of desire and impatience.

You and I stand under the orange tree, faced with the
bearing and believing of the thing. We've
read the history of this relationship in the equation
of our chemicals. The same tree rounds
questions, ripe, above our heads.

Too many circles have burst at our feet, the
swollen and soured release. No sound.
You and I will pluck them off and bear the sin of
breakfast in bed, tear off the soft flesh and follow the
evolution of our punctuation.

The Name of Everything Before Dying

There is a book of childhood names on my dresser. I
thumbed through them for inspiration today, but could not
find one that didn't sound like a Greek god, already taken,
already defined. There is one, though – it means only half a woman –

she that is defined only by love. I wonder now
at the ritual of names, the essential meaning
in words given us before we were ourselves,
attempts to shape and define the soul – another question of myth be-
cause

I want to say that the soul is just the secret you never tell anyone:
a one-word revelation. I've imagined death to be
a sort of abracadabra, then, when we'll be pulled out
of the black hat of ourselves in various postures of rebirth – stunned
and radiant.

There are names full with history in this book.
I have known pangs like envy when I mouth
those that ring whole, complete, hanging like clean white
laundry in my memory. Their names turn keyholes, signifying one
thing.

But still I come back to the demi-woman and don the word.
Hearing my name in the mouth of one I have loved has been
for me a white moment of pre-death definition,
being cut open like quartz and finding yourself utterly beautiful.

The "Poet Voice"

"When born we inherit what's burning" - Liam Rector

At a café yesterday, I heard
a woman I know read prose she'd written
and today I'm still reading
the sound of it. The occasional slip
into the meter of the "poet voice" as
she stood flaming with something more
than herself–the inheritance of sound.

People say they hate when
authors read in "poet voice",
that chanting submission
to sound–the feeling of the words
disappearing until nothing is left
but the purple horizon of voice. Not
a conversation, they say. People want
to be spoken to.

This woman yesterday, she quoted
a line she'd read, written by a man
who killed himself–a man she knew.
The line about the world burning–
it was not a thing he said to her–
he wrote it before he knew her, but
it's somehow the pattern she remembers,
a thing he wrote into her, a pattern of sound
that made her hear what she reads
now aloud, a rhythm she placed
inside this story and then recited
into this room in the poet voice,
not denying the crying that comes
before the chanting, the translation
into our tradition of rhythm.

That man she knew can then
still speak in his familiar tongue-in-cheek
because it sounds the same when said this way.

I heard him read myself once,
before he went, in his poet voice, pacing
into us the lines on dying. I forgave
the darkness and the words for the sound.
Death, when said like this
was not death, was a thing that we could meet
with sounds we knew,
sounds that he could slip
into those he knew, those like
this woman who later told me his real name–
that poem of himself in a poem, a rhythm
I have always known, though I never knew
the man. It's not a conversation, what he gave
and gives us still through the voice
of a burning woman in a café, but many voices
going back inside each other in the poet's
voice. We share the sound
of the line–the man erased
but speaking then, saying, maybe all
we leave behind is the world burning.
I hear the woman read the line, the sound
that's even in her prose now,
rereading in that voice.

Student Biography

Katelyn Romaine is a junior at Longwood University, currently pursuing an undergraduate degree in Creative Writing. She writes primarily poetry but is interested in pursuing fiction as well. Katelyn believes that her musical education has had a strong impact on the sonics in her poetry: she has received ten years of classi-

cal piano education and has studied classical song interpretation in Paderno, Italy. After graduate school, she plans to pursue a career in editing and publishing to support her writing.

Two Poems

Jessica Fox
Faculty Mentor: Mary Carroll-Hackett and Craig Challender
Department of English

Artist's Statement

As an English major and a creative writer, I am deeply intrigued by language. This is companioned by an abiding respect for those in prior generations who have shared this love of language, experimenting with words, building and creating, exploring what writing means as we are still discovering it today. In order to legitimately appreciate this procession, I had to join myself, adding my own small efforts to the history of using language to creatively make meaning; my poetry, then, is an act of admiration, small steps in the footprints of all those who came before. I write for the value that language offers, for the possibility of creating beauty and the opportunity to express my own world, the world we share. Although, my work is not completely autobiographical, not confessional in the historical sense, I draw on themes encountered throughout my life and my characters are based on people who have left significant impressions on me. I predominantly write about women, specifically in Southern, rural settings. This stems from snapshots of my early childhood and the poems then serves as postcards of a place and time to which I always want to return. Many of my characters find themselves in worlds they cannot control, surrounded by ambiguous elements of nature that are in an equal state of loss or yearning. This yearning and how we come to terms with desires both met and unmet, the questioning of our surroundings embody that which we as humans grapple with everyday. These are the questions I ask in my work, the seeking and burden with which I endow my characters, making them, I hope, more real and familiar.

To get to what cannot be articulated, I often experiment with sound, the sonics of specific words, how they resonate when read together, and how sound deepens the use and impact of the desired image, how all of these poetic elements work toward the final desired emotion produced in the mind of the reader. I strive for first-impression, organic images and symbols that are present in our daily lives. With the help and guidance of my professors, particularly Craig Challender, I have begun to discover how complex a truly well-written poem can be, those layers revealing and creating a feeling of human unity. While as a poet, I still consider my work to be in its most basic formative stages, my own careful steps into the procession, but I plan to continue writing, here at Longwood, and into the future, each effort my continuing respect for our language and those who make meaning and lives of it.

Age Nine with Mother

Summer was sitting in my mother's
black tar backseat, listening to crickets
make scratchy hiccuped love.
She would be on the hood of the car,
in dresses too tight and so long,
dividing money into meals, electric
bill and Bud,
money made in the evenings
at Roy's Diner filled with pinched
ass, sugared smiles, and "Roy, I'll count the register tonight."

When the drawer was twenty dollars short,
we shared limeades and bean burritos, giggling over the stares of the
man pumping
the scent of our gas.
She would sing Janis in low notes
playing finger drums on my back.
"Beats," she said, that moved the moon.
At night she would be fields away,
a fairy queen fucking
men made of worn cotton,
car oil, and ash.

She'd wake me for the sunrise,
warm arms wanting the weight
of a child. We'd listen to birds
cramming coarse lyrics into dark
air, pounding
wings out of passion.
Summer in the backseat
when we drove, always fast,
I thought the moon followed me.
Now I know it lingers over

those found in fields
who keep tempo with the tides.

The Apple That Crawls Away From the Tree

They let fruit rot,
softening on the kitchen counter.
Sixteen year acquaintances of burnt
conversations over dinner.
There is so much to say,
but no air to carry the tune.

They become acquainted with their couches.
talking in sighs under the hum
of the refrigerator. I pretend
that their faces fake tears
as the reruns reveal the nightly news.

It is my questions that keep me there,
molding my face in the hall mirror
to something they can recognize:
4.0, grad
school, Mercedes Benz.
When they dream

its listening to the wind
weeping, defeated
on the porch,
begging back the breath
of the birds,
all pickled ginger
and mold.

My eyes become callused
watching them run,
return, repeat .
I want them to know
I do not need two stories
2 1/2 baths, company holiday parties
plastic backyards. It is what

they do to stand the silence-
leave me lying

head cradled by concrete,
I stare at the stars,
those holes in God's eye lids.
I urge him to blink. Twice,
to be sure.

Student Biography

She is currently pursuing a Bachelors degree in English and Education with a minor in Creative Writing. As she enters her last year, she is considering graduate studies in Creative Writing.

Faculty Biography

Mary Carroll-Hackett took the MFA in Fiction from Bennington College in June 2003. Her work has appeared in *Carolina Quarterly*, *Clackamas Literary Review*, and *Reed*, among numerous other literary journals. Her first book, *What the Potter Said*, was released in July 2005. Her scripts have won or placed in competitions across the country, including Moondance, Great Lakes film Festival, the Beaufort Film Festival, American Gem, Gimme Credit, and the prestigious PAGE Awards. As winner of the Wildsound Film Festival Screenwriting Competition, her script *Outer Banks* was staged at the National Center for Film in Toronto this year. She currently directs Creative Writing at Longwood University, where she also founded and edits *The Dos Passos Review* and *Briery Creek Press*, and administers the Liam Rector First Book Prize for Poetry.

A member of the Longwood English faculty since 1983, Craig Challender teaches American literature, creative writing, mythology, and drama, among other interests. His publications include three chapbooks of poetry and two full-length collections: *Familiar Things* (Linwood Publishers, 1998) and *Dancing on Water*

(Pecan Grove Press, 2005). He has been a finalist for the Virginia Poetry Prize, the Capricorn Prize, and The Journal Ohio State University Press Prize. Individual poems have appeared in *Tar River Poetry*, *South Carolina Review*, *South Dakota Review*, *Midwest Quarterly*, *Paterson Literary Review*, *Northeast*, *Southern Humanities Review*, *The Chrysalis Reader*, *Sycamore Review*, and *Arts & Letters*, among others.

6 Visual Art

Untitled

Mike McAteer
Department of Art

Figure 1: Mike McAteer - Unititled

Room 9

Alex Grabiec
Department of Art

Artist Statement - Alex Grabiec

These are photographs about the idea of home. As images they will be approached by the viewer as photographs are traditionally viewed, as a section of reality or something real. However, the shifted focal plane allows for the eye to see a change in the photographed scene. An average kitchen table turns into a miniaturized version of itself, looking like it would belong in a doll house. This change in the reality makes the viewer think about the things in his or her home. Chairs, tables, coffeemakers, couches and lamps become things that are constructed in the home that, in the photographs, appear to have a fake quality about them. Our homes are filled with these constructed things. We gather objects because of some desired function or aesthetic quality about them in order to build our concept of home.

Figure 1: Alex Grabiec - Room 9

Two Photographs

Laura Nodtvedt
Department of Art

Figure 1: Laura Nodtvedt - Gracie

Figure 2: Laura Nodtvedt - Emily

Bowling Lanes Night

Nick Costa
Department of Art

Artist Statement - Nick Costa

The world is full of interesting spaces, but it is not every day that we get a chance to stop and appreciate the indoor spaces around us. Every nook, cranny, corner, hallway doorway, stairwell, and foyer has its own story and its own history. In our busy lives we pass through these spaces and rarely take time to understand their construction and function. When entering a large indoor space, we have to turn our heads and subconsciously piece together our surroundings. Through memory we remember these spaces and their shapes, but as amazing as human eyesight may be, we never are able to see it all at once. Through my studies as a photographer, I have always dreamed of seeing more in a single frame, and while wide angle and fisheye lenses offer a large view radius, they lack accuracy in depicting perspective. I have found a new way to show my audience an entire space in a single representation through the use of mathematics and computers. Not only are the viewers able to see the three-dimensional spaces in a two-dimensional plane, they are also able to see how these spaces are used at different times of day and what effects light has on the subjects involved. It is my goal to engage the viewer in intimate exploration of the places we see on a daily basis as well as to give the audience a fresh perspective on how we see these places.

Figure 1: Nick Costa - Bowling Lanes Night

Two Paintings

Rachel Wolfe
Department of Art

Artist Statement - Rachel Wolfe

The focus of my work is to draw attention to what is overlooked. In both paintings and drawings, my works depict landscapes, still lives, and occasionally figures, with an emphasis on time and antiquity. I use objects and places... as narratives expressing an appreciation for what has been in the past and the evolution to the present.

Figure 1: Rachel Wolfe - Can & Kettle

Figure 2: Rachel Wolfe - Scarecrow

7 Theatre

Exploring Henrik Ibsen's *Peer Gynt*

Zack Dalton
Department of Theatre

Artist Statement and Program Note on the Dramatuge

> "Tell me and I'll forget, show me and I may remember, involve me and I'll understand." -Chinese Proverb

Peer Gynt was not originally meant to be performed; Ibsen intended it to be an epic poem that was to be read aloud, much like The *Iliad* or The *Odyssey*. It was only years after writing it that he realized the magical qualities of the piece and adapted it for the stage. Due to the epic quality of the story and the outdated language, *Peer Gynt* is a very difficult play to produce. In its entirety, *Peer Gynt* is over three and a half hours long.

When Dr. Gene Muto approached me to help adapt Peer for our season, I have to admit, it was a little daunting. How do we edit this close to four hour play to create a reasonable two hours without losing the heart of the story? The biggest challenge was making the play accessible to modern audiences. The central theme of the play is the discovery of the self, a common issue that we all face during various stages in our lives, so that was a topic we all would understand. However, translating that into terms our 21st century minds would be able to grasp was the challenge. This led to the addition of what one would call a narrator, someone to help the audience wade through this somewhat difficult material. Scenes were cut, as was to be expected. All in all, after a few weeks of working non-stop, a smaller, more concise *Peer Gynt* was ready for Jarman's stage.

As this was my first assignment as a dramaturge, it was a learning experience all the way. The job of a dramaturge varies from theatre to theatre, but usually he assists in the editing of plays for a company and attending rehearsals to help

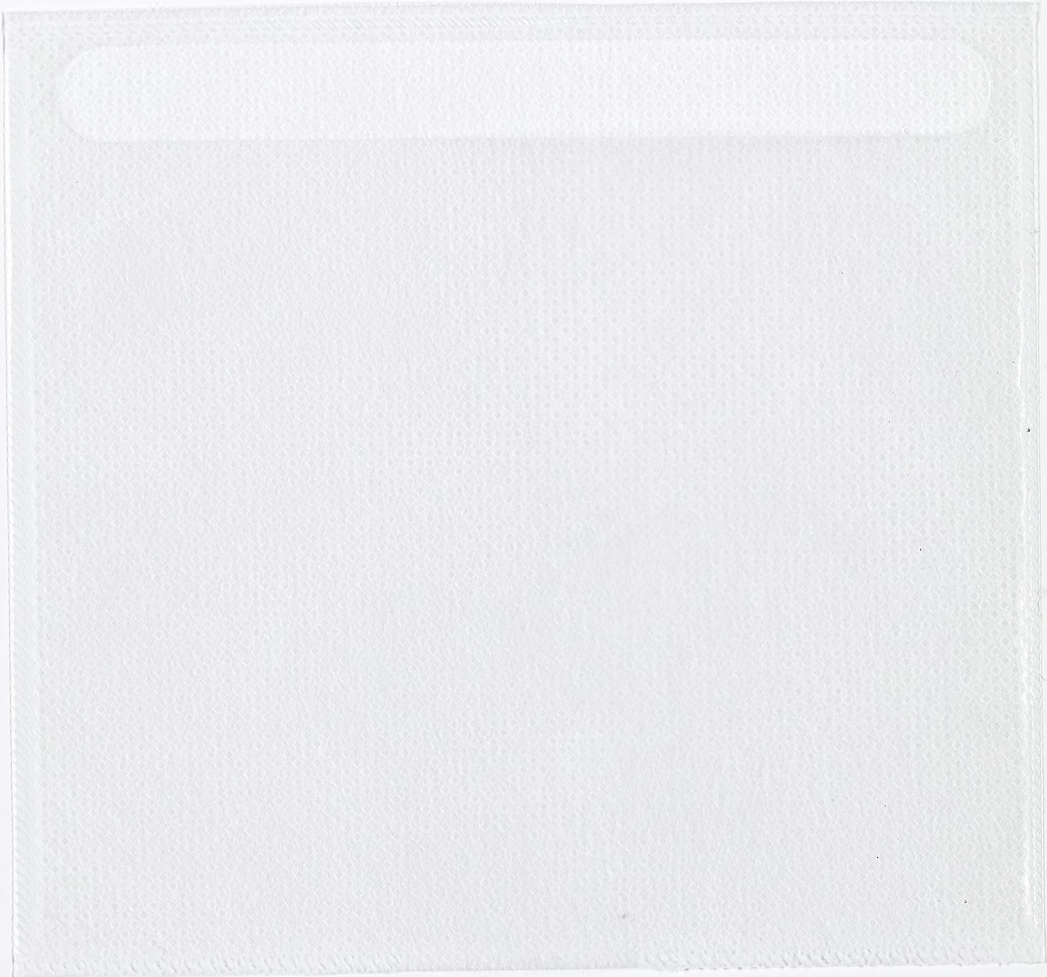
with any literary issues that may arise. The dramaturge speaks for the playwright, whether he or she is deceased or just absent. As this is something I would like to do as a career, I am thankful that I actually got to do it in practice; most other undergraduate Theatre programs would not take on a student in this capacity; especially on something this large in scale.

Student assistant designers were in abundance for *Peer Gynt* due in part to the epic breadth of the production. Zac Campbell, class of 2009, served as Assistant Scenic and Lighting Designer. Senior B.A. student, Annaliese Weber assisted in the design of costumes. Kate Wackerle, senior honors student, designed sound under the mentorship of Asst. Professor Eric Koger. Student designers gain working knowledge of behind the scenes processes and procedures. They are engaged beyond the classroom in real world situations with the safety net of an educational environment. Student designers research specific areas as they pertain to the script, critically analyze renderings and drafting plates, participate in hands-on creation of production elements, experiment with different materials or ideas, apply critical thinking methods, and problem solve the logistics of a theatrical production.

We invite you to view the enclosed DVD to experience student interviews about their process.

Student Biography

Zachary Dalton, sophomore theatre major, explored and examined Henrik Ibsen's rarely produced masterpiece, *Peer Gynt* in fall 2007. As dramaturge, he was integral to the adaptation of the script for staging. A dramaturge serves as a literary advisor to the director, basing script edits on other works by the playwright, overall theme of the play, research into the playwright's intent, and past productions of a piece. Zachary's charge was to edit in a way that would be true to the original without seeming choppy or disjointed.



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