



**McNair Research Journal**  
THE UNIVERSITY OF TEXAS AT ARLINGTON

Summer 2007 • Volume 11



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THE UNIVERSITY OF TEXAS AT ARLINGTON

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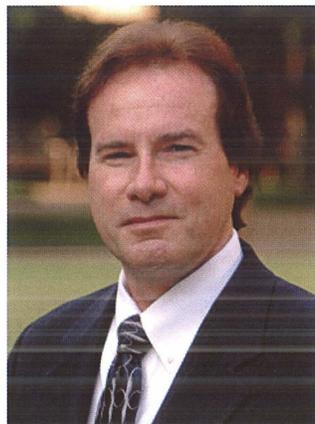


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## Message from the Interim Provost

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Ronald McNair was a man who reached for the stars. As an African-American who grew up in the South during the 1950's, he overcame tremendous obstacles to earn a Ph.D. in Physics from MIT, and ultimately served his nation as a NASA astronaut. De-

spite his death in the 1986 explosion of the space shuttle Challenger, he remains an example of how anyone from any background, with the desire, dedication and drive, can succeed when given an opportunity. It was from his passion to succeed that the McNair Scholars program was born.

As participants in the McNair Scholars program, UT Arlington students are given the opportunity to explore the world around them by engaging in original research under the guidance of a faculty mentor. The program culminates with a Research Symposium at which the students present the results of their research, sharing their accomplishments with the community. This program is truly rewarding for the mentors, students and their families, as it fosters a

genuine sense of achievement, the most effective catalyst for continued success.

What better to pay tribute to a true American hero such as Ronald McNair by encouraging future generations of talented men and women to pursue their dreams? By accepting the challenges that come with engaging in original scholarship, the undergraduate students who participate in the McNair Scholars program have taken that all important first step in engaging in true discovery and original research. Upon completion of the program, these budding scholars are poised for success as graduate students and – more importantly – as lifelong learners. With their demonstrated commitment to intellectual inquiry, McNair Scholars are equipped for a lifetime of discovery, which will undoubtedly lead to positive contributions to society.

While Ronald McNair is no longer with us, he continues to serve as a role model for perseverance, hard work, and a commitment to excellence. As he once said, "Whether or not you reach your goals in life depends entirely on how well you prepare for them and how badly you want them." Dr. McNair epitomizes the principles upon which our nation has been built, proving that anyone truly dedicated to a dream can succeed – even in a quest to reach for the stars.

A handwritten signature in cursive script that reads "Ronald L. Elsenaumer".

Ronald L. Elsenaumer  
Interim Provost

## Notes from the Director



The year 2007 has been an extraordinary one for the McNair Scholars Program at The University of Texas at Arlington! In addition to our fourteen interns conducting exceptional research as evidenced in the summaries on the following pages, the program was able to increase intern stipends from \$2,800 to \$3,000, and to offer three tuition credit hours during the eleven-week internship— each made possible by the generous and visible support of UT Arlington administration. Appreciation is extended to President James D. Spaniolo, Interim Provost and Vice President for Academic Affairs Ronald L. Elsenbaumer, and Senior Vice Provost Michael K. Moore.

I further wish to extend my gratitude to the faculty mentors who guided our Scholars during their research experience and who encouraged them to pursue a path towards graduate education. Their guidance and support have allowed our Scholars to grow in meaningful and significant ways while giving them the foundation to enter graduate school with confidence and solid research experience.

Finally, I offer my heartfelt congratulations to our Scholars on the completion of their summer research internships. You are to be commended on your diligence, your perseverance, and your ability to stay on task throughout the research experience. Be assured that through your research, you have advanced the knowledge in your chosen field.

Best wishes, McNair Scholars, on your continued academic success!

A handwritten signature in cursive script that reads "Kathryn Head". The ink is dark and the signature is fluid and elegant.

Kathryn Head  
Director of SOAR/McNair Scholars Program

## Staff Members

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## Acknowledgements

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## The McNair Scholars Program



Dr. Ronald E. McNair/Scholar, Scientist, Astronaut, 1950-1986

The history of the McNair Scholars Program at UT Arlington commenced in 1990 when the U.S. Department of Education funded a grant proposal to bring it to campus. The goal of this program (and of the many McNair programs nationwide) was to assist disadvantaged undergraduates—either first-generation/low-income and/or underrepresented (African American, Hispanic, Native

American) students—to prepare for future graduate study culminating in the Ph.D. and a life of research and teaching. Since its inception on campus, the McNair program has encouraged and assisted over two hundred students in various majors with their preparation for graduate study.

Currently the McNair Scholars Program at UT Arlington works with a minimum of twenty-five students (sophomores through seniors) each academic year, providing seminars and classes on a wide range of topics relating to graduate school, offering a spring institute to heighten Scholars' understanding of the culture of research, and, subsequently, affording them the opportunity to engage in one summer of research with a faculty mentor prior to graduation. The program also enables Scholars to present their research at McNair (and other) undergraduate or professional conferences, provides guidance with the graduate school application process, and funds graduate school visits.

The McNair Scholars Program at UT Arlington enjoys strong, campus-wide support and greatly benefits from the expertise and enthusiasm of its faculty and staff. An expression of this institution's commitment to McNair Scholars was the creation of the UT Arlington McNair Graduate Assistance Package (M-GAP) in spring 2002, offering a fellowship/assistantship combination in a wide range of disciplines.

## Friends of the UTA Library McNair Scholarship Awards

During the 2004-2005 academic year, the Friends of the UTA Library generously created an award for outstanding McNair Scholars based on their summer research presentations, the culmination of the McNair Summer Research Internship. Moreover, the Executive Board of the Friends established an endowment and instituted a fund-raising effort to make this award annual. On August 9, 2007, the McNair Scholarship Committee members and Dean of the UTA Library attended a full day of McNair research presentations (fourteen total) in College Hall, taking notes and posing questions to presenters. At the November 9 meeting, the Friends of the UTA Library presented McNair Scholarships to the two students who had, according to their assessment, made the overall best research presentations. Yonathan Tafesse and Omid Zaré-Mehrjerdi



Yonathan Tafesse



Omid Zaré-Mehrjerdi

each received a \$500 scholarship and a distinctive plaque. The UTA McNair Scholars Program congratulates both Yonathan and Omid on their excellent work and thanks the Friends of the UTA Library for their ongoing support.

### PREVIOUS MCNAIR SCHOLARSHIP AWARDEES

#### FALL 2006

Samuel Odamah (Architecture)

Mentor: Prof. Gary Robinette

Monet Joseph (Biology/Biomedical Engineering)

Mentors: Drs. Kytai Nguyen and Hanli Liu

#### FALL 2005

Bianca Canales (Political Science)

Mentor: Dr. Victoria Farrar-Myers

Rachel Hansen (Biology/Biomedical Engineering)

Mentor: Dr. Raul Fernandez, ARRI

Faith Nibbs (Anthropology)

Mentor: Dr. Josephine Caldwell-Ryan

### DEAN OF THE UTA LIBRARY

Dr. Gerald Saxon

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Linda Simmons

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Greg McKinney, *Treasurer*

Linda Simmons, *Secretary*



## The Image of the African in Early Europe

CODI RENEE BLACKMON

Mentor: Thomas Ryan, Ph.D. (Department of English)

### ABSTRACT

Despite the fact that Africans and people of mixed African and European heritage have made major contributions to European history and culture, racial discrimination against Africans has been present since the Middle Ages. This study not only explores the true history of the African in relation to the images of Africans present in the religion and society of early Europe but also analyzes literature from early periods that involve African characters or contact with African peoples. Evidence of the negative sentiments toward Africans can be found in the literature of medieval and early Renaissance Europe; however, to say that all European attitudes towards Africans were negative is false. To set up this kind of dichotomy, where black Africans are portrayed either positively or negatively, is to overgeneralize. This study found many instances

where negative and positive descriptions of Africans were present within the same text. Valiant knights such as Sir Morien, *The Black Knight*, and *Othello*, Shakespeare's famous protagonist, were both praised for their valor but scorned due to their race. Also, individual Africans, such as the three African popes, numerous black saints, and other African models of Christian charity, were praised and lauded, even revered during this time. Yet at the same time, naive and misinformed individuals thought Africans to be wild, unruly human beings, and the racial prejudices held against them were therefore thought to be justified. Recent scholarship, however, has proven untrue these ill-advised notions about Africa, its inhabitants, and people of African descent.



## La Femme du Modernisme

DEJANIRA CASTILLEJOS

Mentor: Christopher Conway, Ph.D. (Department of Modern Languages ~ Spanish)

### INTRODUCTION

This study is an analysis of the portrayal of the female in Rubén Darío's short story "El rubí." The principal goal is to determine how nineteenth century society's view of woman altered the traditional roles of men and women. In *Modernista* literature, the literary movement which Darío led, women were typically portrayed in two ways: the femme fatale, the seductive destroyer of Man, and the submissive and voiceless woman. However, in an unusual moment of *Modernista* representation, Darío critiques patriarchal definitions of woman. Darío addresses gender injustices in "El rubí" through complex symbols related to jewels (rubies and diamonds) and biblical allusions. In this story, Darío gives voice to voiceless women by exposing men's weaknesses and violence toward women.

### LITERATURE REVIEW

In Spanish American literary history, the older generation of critics, such as C. Rangel Baez, Abelardo Bonilla, Pablo Antonio Cuadra, and Roberto Armijo regarded *Modernismo* as a movement concerned exclusively with the aesthetic, with the artistic side of literature. In his book *Rubén Darío y su intuición del mundo*, Armijo declares that "Rubén Darío careció del sólido andamiaje filosófico que sirviera de soporte mental a su obra. El sedimento de su mundo ideológico, es pobre, limitado" (*Rubén Darío lacked the philosophical foundation that would serve as a mental support for his work. The basis of his ideological world is poor and limited*) (Ellis 67). I depart from the older canon of Latin American literary criticism and ally

myself with the following seminal, groundbreaking studies on *Modernismo*, *Modernismo, Modernity, and the Development of Spanish American Literature* (1998) by Cathy Jurade, *Critical Approaches to Rubén Darío* (1974) by Keith Ellis and *La cultura moderna en América Latina* (1985) by Jean Franco. These critics have emphasized the ways in which writers reacted to the times and address the issues of the day in a more profound, philosophical way. Like them, I treat *Modernismo* ideologically, not merely as an aesthetic movement detached from society. In my study, I note that Darío touches on several socio-political themes in his work, particularly the vulgarity of the modern bourgeois, a theme which I examine in some detail in relation to his story "El Rey Burgués." In this story, modernity and mechanization lead to the loss of individuality, spirituality and aesthetics.

### METHODOLOGY

My approach reflects a materialist conception of literature. Literature reflects social problems and needs to be understood historically and socially, not simply as art. My paper is feminist insofar as it emphasizes gender roles and women's experiences of oppression. Taking into account Darío's linguistic mastery, my analysis is also based on an etymological and historical critique. My analysis reveals the unusual stance Darío takes in "El rubí" in respect to the deference he shows to woman and the social criticism he clearly directs towards man.

## RESULTS AND DISCUSSION

Early critics posit that "El rubí's" subject matter is a narrative of the creation of art, but Darío's symbolism provides substantial evidence to discredit that assumption. I believe that Juan Valera (Spain, 1824-1905) misreads the symbolism in "El rubí" as he comments about the artistry involved in the creation of the first authentic ruby. In the "Carta/prólogo a Rubén Darío," which he wrote for Darío's book *Azul*, he posits, "Es un hermoso mito, que redundaba en alabanza de Amor y de la madre Tierra" (*A beautiful myth which abounds in praise to Love and to Mother Earth*) (*Azul* 21). Valera equates the act of rape that resulted in this woman's death and "created" the ruby to a "beautiful myth." My reading demonstrates that "El rubí" contains symbolism and imagery related to the intrinsic qualities and etymological definitions of the precious stones and the biblical story of Eden that clearly directs the reader away from that interpretation.

I argue that both the natural ruby and the artificial ruby represent woman. The natural ruby is a woman who is "natural." This is a woman who lives under the established social order. She lives a life of quiet submission. The artificial ruby is the woman who embraces alternative gender values, and a different ideology promoted by the Parisian bourgeoisie. She is "the other," the woman who uses her voice to demand respect. "Darío's female other—muse poetry, poetic discourse—starts out changing her traditional and conservative Spanish attire for the less constraining fashions of French couture so that she may be free to do new things and be perceived in a new way" (Jrade 144). Moreover, Paris was the international mecca for this emerging lifestyle of free expression.

In my analysis, I show how the male protagonist objectifies and destroys woman by treating her as an object. The other male characters reject women's freedom, a rejection expressed in their response to the false ruby. They refer to it as a "false rock," one without facets. In other words, a pointless ideology. They take this new ideology, break it, and throw the fragments away with great contempt. After their vindictive labor was completed, the gnomes stood hand in hand over their rubies and danced about. Men had united and stood in dominion over women. The gnomes celebrated their triumph because they had destroyed this new ideology.

## CONCLUSIONS AND FUTURE RESEARCH

Rubén Darío was a master of the language. He carefully selected terms with a double entendre to name characters, places, and things. His works typically reflect semantic ambiguity. In the future, I would like to continue with a comprehensive etymological study of Rubén Darío's *Cuentos completos*, *Azul*, and *Prosas profanas*. It would also be interesting to trace a schema of the literary forms and themes present in his literature and, moreover, to assess his use of sensation and evocation that gives symbolic associations to his motifs. In my future research, I would like to include a study of the symbolism and imagery to show how they function and lead to a sense of unity evident in Darío's work.

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## An Analysis of the Fair Employment Practices Committee in World War Two

**RADHAMES MIGUEL VILLAFANA**

Mentor: George Green, Ph. D. (Department of History)

### INTRODUCTION

Many Americans tend to link the origins of the civil rights movement with events like Dr. Martin Luther King, Jr.'s "I Have a Dream" speech, or images of water hoses being turned on nonviolent demonstrators. While such powerful moments are indeed a part of that history, and that of America itself, the movement can trace its roots to at least one prior generation, to a broader conflict and a much more dangerous time. The purpose of this paper is to document the history of the rise and fall of the President's Committee on Fair Employment Practices—later known as the FEPC—utilizing primary accounts of discrimination as well as secondary documents chronicling its troubles. Indeed, from its hard-fought inception to its quick demise the FEPC constantly fought off external and internal efforts to hinder its mission to document and deal with grievances related to workplace discrimination. While the Committee itself was ultimately unsuccessful in changing America's attitude regarding equal rights in the workplace, its efforts nevertheless laid the foundation for the next generation of civil rights leaders.

### LITERATURE REVIEW

Other works in this field of research chronicle various aspects of the Fair Employment Practice Committee, sometimes with specific regard to its involvement in the growing civil rights movement or to the controversies it provoked—especially in the American Deep South. Some of the works cited include Clete Daniel's *Chicano Workers and the Politics of Fairness: The FEPC in the Southwest, 1941-1945*; Maggie Rivas-Rodriguez' *Mexican Americans and World War Two*; Louis Ruchames' *Race, Jobs & Politics: The Story of the FEPC*; and Robert C. Weaver's article "The Economic Status of the Negro in the United States". Thus, the goal of this research paper is to combine both approaches as well as look at analyzing the controversy it provoked within the Democratic Party that created it.

### METHODOLOGY

In addition to using secondary sources, I also conducted primary research in the Southwest Fair Employment Practices Committee Microfilm Collection at the University of Texas at Arlington. I evaluated an extensive list of discrimination grievances filed with the FEPC, as well as general

intra-Committee correspondence. I also utilized the Federal Register's Executive Orders Disposition Table.

#### RESULTS AND DISCUSSION

Based on my research, the results of the Committee were mostly negative. Foremost was the fact that the Committee was opposed by a significant portion of President Roosevelt's own party, as well as the broader American populace. The Executive Orders that brought it to life gave it little, if any, abilities other than to threaten to investigate the guilty parties. In fact, as shown in my research, many employers (and unions as well) were quite open in admitting discriminatory hiring/promotion/pay issues. Furthermore, because the Committee lacked its own enforcement power, employers and unions that engaged in discriminatory practices often either temporarily agreed to work with the Committee (because they knew its mandate was for wartime only), or offered a plethora of reasons as to why the Executive Orders did not apply to them. This fact, I believe, above all others—e.g., *real* enforcement powers behind Executive Orders—would be a catalyst for the next generation's civil rights leaders.

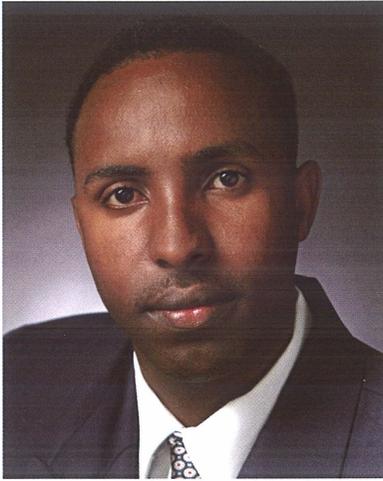
#### CONCLUSION

If one were to grade the Committee in terms of its stated goals and whether it accomplished them, it would receive a "D". It was never given a real chance to stand up for itself and help the millions of minority workers who simply sought the American dream. It did, however, bring to light issues of job-related discrimination ranging from the shipbuilding industry to the laundry industry; from

cotton mills to trucking companies. In that sense it should be commended because it persevered in not only documenting said issues for posterity, but also in informing the rest of the country of the fact that discriminatory methods were holding America back from utilizing her full might in fighting fascism.

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## Use of Filtering to Improve the Estimates of Low-cost GPS Systems Using Known Geometric Configurations of Multiple GPS Receivers

HUSEIN ANSHUR

Mentor: Brian Huff, Ph.D. (Department of Industrial and Manufacturing Systems Engineering)

### INTRODUCTION

Land mine casualties are one of the main challenges that we face today; especially in war-torn countries. It is estimated that there are as many as 100 million land mines installed in as many as 64 nations across the globe [CNN97]. Yearly fatalities associated with land mines are as high as 26,000 people per year, most of whom are non-combatants [CNN97]. A land mine can be purchased for as little as \$3 to \$30, but once installed costs are estimated to be \$300 to \$1000 per mine to locate and remove [CNN97]. Mine detection robots, or autonomous vehicles, have been proposed as a promising tool to assist in both military and humanitarian mine detection activities. One of several technological challenges associated with utilizing autonomous vehicle technologies for mine detection is localization (determining the precise location of the vehicle with regard to a known reference frame). Very expensive real-time kinematics differential global positioning systems (GPS) solutions that can determine the location of a roving GPS receiver to within one to two centimeters are available. These systems, however, currently cost over \$20,000 [Ala06].

### PRIOR RESEARCH

Vinu Jose Alappat, a graduate student at the University of Texas at Arlington, proposed the use of multiple low-cost sensor nodes as an alternative to expensive differential GPS pairs. In a detailed study using multiple low cost GPS receivers, Alappat demonstrated that the location predictions of any given node could be improved by considering the location predictions of other nodes laid out in a known

geometric pattern [Ala06]. This research expands upon Alappat's original work to develop a new approach that will decrease the cost of land mine detection systems by utilizing differential GPS based on a constellation of low cost GPS receivers to improve localization accuracy. Multiple GPS units configured in a known geometric pattern, in combination with Kalman filtering technique, will also be used to improve positioning accuracy by removing errors reported by the individual GPS receivers. The filtered position will then be used to estimate the node's location.

### METHODOLOGY

This work uses multiple filtering methods to process latitude and longitude data obtained from multiple GPS receivers laid out in a known configuration. The raw GPS locations for all of the nodes were first converted from latitude and longitude values to meters of displacement from the origin of an arbitrarily defined local coordinate system in which the Y-coordinates represent displacement in the North/South direction and the X-coordinates represent displacement in the East/West direction. The mean and variance of the displacement in the X and Y directions were calculated for each stationary GPS node.

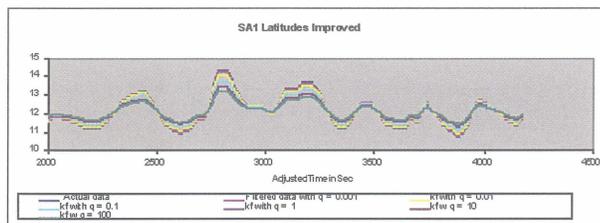
A Kalman filter was used to estimate the X and Y displacement in meters for each of the nodes in the GPS receiver constellation. A Kalman filter is a recursive data processing algorithm that estimates the state of a noisy linear dynamic system. This type of filter assumes that the measurements of the system are linearly related to the state of the dynamic system and are corrupted by noise. If these noise sources are Gaussian distributed, then the Kalman

filter estimator is statistically optimal with respect to any reasonable measure for optimality [Neg03].

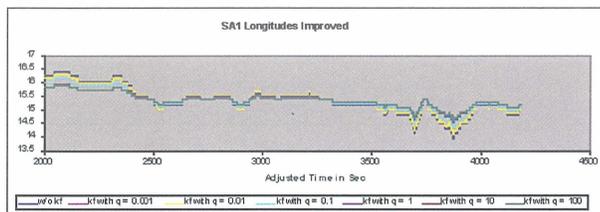
A geometric fitting technique was also used to compare the known physical displacement of the GPS receiver nodes relative to each other with the displacement values reported by each of the nodes. This method was developed to remove the systematic location errors reported by all nodes. The method uses the location variance values calculated for each node to rank the repeatability of the location values generated by each GPS receiver. An algorithm was developed to use the known geometric relationships from the receiver constellation to generate correction values for each GPS receiver. These correction values were then used to adjust the location mean estimates obtained from the GPS receivers.

#### RESULTS AND DISCUSSION

The geometric fitting methods are still under development but preliminary results indicate that this method can be used to estimate the systematic error found in the means of the GPS locations obtained from the receiver nodes.



Graph 1A. Displacement in Meters.



Graph 1B. Displacement in Meters.

The application of Kalman filtering techniques were successful in reducing the location errors reported by each of the stationary GPS receiver nodes. The graphs indicate that the location errors of our stationary nodes can be reduced by as much as two meters for our latitude readings and in the range of one meter for our longitude measures. Similar improvements were found for all nodes. The graphs also indicate the presence of cyclical errors. These patterns were seen in the location estimates obtained in several of the GPS receivers used in the study. The presence of this systematic source of error violates the Gaussian distribution assumptions associated with Kalman filtering.

#### FUTURE RESEARCH

To minimize the effects of these cyclic errors, future research will investigate the use of time-series filtering methods to remove these temporal fluctuations prior to applying the Kalman filters.

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## The Role of the Olfactory System in Mate Recognition and Sexual Discrimination of *Drosophila melanogaster*

ERIKA CRESPO

Mentor: Pawel Michalak, Ph.D. (Department of Biology)

### INTRODUCTION

The reason for the sexual isolation between the two sub-groups of *D. melanogaster* has been an area of great interest in evolutionary genetics for years. The Zimbabwe population shows a high preference for selecting mates from within its separate sub-group, while the Cosmopolitan morph exhibits no sexual discrimination (Wu *et al.*, 1995). We believe that the reason for the strong isolation between the two populations is the result of differential organization and function of their olfactory sensory systems, consisting of the antennae and the maxillary palps which contain the olfactory receptor sensillae (Clyne *et al.*, 1999). Courtship behavior in *Drosophila* consists of an exchange of auditory, visual, gustatory, and chemosensory signals between males and females (Markow & O'Grady, 2005). These shared odorants enter the sensilla through pores or grooves in the cuticular wall, dissolve in the sensillum lymph, and activate ORN which send axonal projections to three glomureli of the antennal lobes (Couto *et al.*, 2005). The removal of this structure will determine whether any differences in the composition of the olfactory systems between the Z and M populations of *D. melanogaster* are the source of their sexual isolation. We hypothesize that in removing the antennae, and consequently the ORNs responsible for receiving the pheromones involved in initializing copulation from Z females, they will display a more uniform mating selection.

### LITERATURE REVIEW

*Drosophila* flies provide vast opportunity for understanding the complexity of speciation, mostly because of their easiness to maintain (Mallet, 2006), and they have been used to provide a perspective on this phenomenon for more than 20 years (Coyne and Orr, 1997). In 1999, 59 genes were found in *D. melanogaster* to be presumably olfactory receptor genes based on their structure (Clyne *et al.*, 1999; Gao &

Chess, 1999; Vosshall *et al.*, 1999). In 2001, 32 of the 59 genes discovered in 1999 were determined to be located in the funiculus segment of the antennae (Störtkuhl and Kettler, 2001). In 2007, a study by the Michalak lab detected 45 genes that displayed differential expressions between Z and M flies, as well as differential expressions between mated and non-mated Z females. Of those 45 genes, four were extensively analyzed using QRT-PCR. Only one, the *Odorant Receptor 63a* gene, showed a statistically significant difference that suggested a main involvement in the genetic source for the Z and M severance.

### METHODOLOGY

The *Drosophila melanogaster* fly stocks were reared in uncrowded cultures at 24° C with a 12-hour light/dark cycle on Carolina 4-24 formula (Michalak *et al.*, 2007). Three Zimbabwe isofemale lines (designated Z) were used: Z30, Z49, and Z53. The Cosmopolitan isofemale line (designated M) EC175, collected in Ecuador, was used. We conducted seventy-one multiple choice experiments, all completed in late morning. The experimental group of Z females had their funiculus and arista, the third antennal segment, removed; while the control group of Z females was not physically altered. All flies were seven days old at the time of mating. Virgin Z females were placed with virgin Z males (from the same line) and virgin M males in a glass vial. The mating was monitored for at least two hours, and the copulating pairs were transferred into a separate vial. Once there was no more sexual activity, the removed pairs were placed on a CO<sub>2</sub> stage to confirm the male population line.

### RESULTS AND DISCUSSION

From observing the number of mating pairs from the multiple choice experiments, the third antennal extraction did not reduce the discrimination against the M males. Surprisingly,

the Z females, without their funiculus and arista, showed even more of a partiality toward the Z males. To confirm a statistical differential between the experimental and control selections, the Fisher Exact Test was performed. Based on the 2-Tail computations from the test, only Z30 displayed a distinguishable increase in their mating preference on account of the antennal removal. The Z53 and Z49 lines displayed no differences in the frequency of mate selections between the experimental and control groups.

The results of the Fisher Exact Test for the Z53 and Z49 did not show a disparity in the conclusion of the experimental outcomes because those isofemale lines did not have a high enough number of mated pairs collected. In order to conclude that there is a differentiation between the experimental and control groups, the 2-Tail computations must be equal to or less than 0.05, and only Z30 showed such results. Based on the results gathered, it cannot be concluded that the olfactory system solely controls the selection of mates for *D. melanogaster*. However, its removal hindered the normal activities of the Z females. The behavior during courtship is primarily evoked by sex hormones (Cobb & Jallon, 1990). An earlier study revealed that when female diene levels are low, both increased copulation dormancy and fewer copulation attempts were made (Ueyama *et al.*, 2005). The production of these female pheromones is the source of the sex appeal of the female *D. melanogaster*, which signal the males to initiate courtship and mating (Chertemps *et al.*, 2006). The extractions probably altered the release of these key chemicals required for communication. Furthermore, the arista is the organ that receives the auditory vibrations, such as those from wing vibrations (Markow & O'Grady, 2005). Without the funiculus and the arista, which together function as one mechanoreceptor unit (Markow & O'Grady, 2005), the experimental Z females were not able to receive the auditory signal associated with courtship. This evidence supports the suggestions of the results of the Z30 isofemale line's mating selections; that the removal of both the funiculus and arista affects the natural mating selections of the Z and M populations of *D. melanogaster* and strengthens the usual isolations between the two morphs.

#### CONCLUSION AND FUTURE RESEARCH

The extraction of the third antennal segment did not inhibit the natural sexual isolation between the Z females and M

males. Contrastingly, based on the numbers of copulating pairs collected, the segregation was reinforced for all three Zimbabwe isofemale lines. Further research would include additional multiple choice experiments using experimental Z53 and Z49 females to ensure whether or not the removal of their olfactory systems altered their natural selection of mates. Once such a disparity has been statistically supported, a quantitative real-time fluorescent polymerase chain reaction (QRT-PCR) analysis on RNA samples from all of the *D. melanogaster* used in the experiment must be completed to prove that there are genetic differences present. This would provide the genetic evidence needed to confirm that the olfactory sensory organs, and the genes associated with them, have a significant effect on the behavioral and sexual isolation between the Zimbabwe and Cosmopolitan flies, clarifying the genetic role of behavioral and reproductive traits in speciation.

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## Comparison Study of Drug Release Profile and Cellular Uptake of N-isopropylacrylamide and N-isopropylacrylamide-co-acrylamide Magnetic Nanoparticles

MONET JOSEPH

Mentor: Kytai Nguyen, Ph.D. (Department of Bioengineering)

### INTRODUCTION AND BACKGROUND

Cancer is one of the leading causes of death in the United States. Every year many people become victims of cancer, a disease that is characterized by uncontrolled cell division with the ability to invade other tissues. The irregular growth of these cells is due to DNA damage, which causes changes in genetic materials, thus hindering their control over cell division. Current treatment options available for cancer are surgery, radiation therapy, chemotherapy, and hormone therapy. However, a major problem with these treatments is that they all have many side effects. For example, chemotherapy is unable to target and specifically deliver anti-tumor drugs at a specific location, especially at the tumor region. Therefore, it destroys both cancer and healthy tissues. This non-specific drug treatment causes hair loss, weakness, fatigue, and death in severe cases for cancer patients. Consequently, the success rate of chemotherapy is very low and scientists are investigating new methods for cancer treatment.

The goal of this research is to investigate the drug release

profile and prostate cancer cell uptake between two types of magnetic nanogels: N-isopropylacrylamide (NIPA) and NIPA-co-acrylamide (NIPA-AAm) magnetic nanoparticles. In addition the drug release study, the cellular uptake studies would be conducted to understand the effects of concentration and incubation time on particle uptake by prostate cancer cells.

N-isopropylacrylamide (NIPA) is a polymeric hydrogel that has been investigated extensively due to its thermo-sensitive behavior. It has been found that NIPA is a water-soluble polymer, which will go through a phase transition at a temperature of 32° C.<sup>1</sup> The ideal design would be a material that has thermo-sensitivity at a temperature higher than the body (37° C), thus it could be specifically modulated to release a drug at a precise time and location. Consequently, polymeric coating is applied to magnetic nanoparticles to encapsulate and release drugs. In order to have the controlled release of encapsulated drugs, many polymers have been applied to coat magnetic nanoparticles and load drugs; these materials include bio-

degradable polymers,<sup>2</sup> nonbiodegradable polymers,<sup>3</sup> and thermo-responsive polymers.<sup>4</sup>

#### METHODOLOGY

Magnetic nanoparticles were prepared by a conventional co-precipitation method. The magnetic nanoparticles were coated with vinyltrimethoxysilane via acid catalyst hydrolysis followed by electrophilic substitution of ferrous oxide on the surface of the magnetic nanoparticles. VTMS-coated magnetic nanoparticles were used as a template to polymerize NIPA or NIPA-AAm in aqueous micellar solution using SDS as a surfactant and BIS as a cross-linking agent. Bovine serum albumin (BSA) was used as a model protein drug to study the release behavior of the synthesized magnetic nanogel. Prostate cancer cells were used in order to study the system as an intracellular drug delivery system *in vitro*.

#### RESULTS AND DISCUSSION

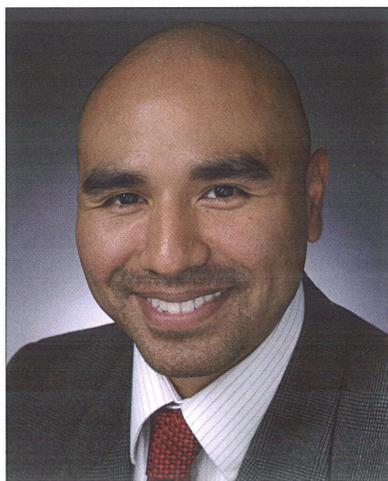
Our results of the drug release profiles show that NIPA-AAm magnetic nanoparticles have considerably higher release curves and particle cellular uptake by prostate cancer cells compared to NIPA magnetic nanoparticles. These results suggest that NIPA-AAm magnetic nanogels are better for use as a targeting drug delivery system to treat cancer diseases.

#### CONCLUSION AND FUTURE RESEARCH

In summary, further testing is required to improve the use of NIPA in targeted drug delivery systems. Future work on this project will include conjugation of antibodies on the magnetic nanoparticles to make them more specific for targeting the prostate cancer cells.

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## R2Bm Retrotransposon: DNA-protein Interactions

ARTURO MENCHACA

Mentor: Shawn Christensen, Ph.D. (Department of Biology)

### INTRODUCTION

The study of genetics in the twenty-first century has undergone a drastic expansion of knowledge that has uncovered what are commonly viewed as parasitic segments of DNA within every organism studied *thus far*. Transposable elements (TE), a general term used to describe all types of parasitic mobile DNA, make up a significant portion of genomes studied to date. There is also a correlation that shows more complex organisms have an even larger fraction of TE in their genomes. To illustrate, 3% of the yeast genome is from TEs (Kim 1998), while in *Drosophila* the figure is 22% (Kapitonov). In humans TEs can account for 46% of the entire genome (Lander 2001). These elements have profound effects on the health and evolution of the human genome because they can cause mutations such as deletions, duplications or inversions. The transposable element that is the focus of this study is R2Bm, a site-specific retrotransposon endogenous to *Bombyx mori* (silk moth).

### PRIOR RESEARCH

R2Bm is categorized as a non-LTR retrotransposon. It replicates through target primed reverse transcriptase (TPRT), and specifically recognizes the target sequence located in the 28S ribosomal DNA of its host. R2Bm has a single open reading frame that produces a multifunctional protein. The R2Bm protein has a DNA binding, reverse transcriptase (RT), and endonuclease domain encoded in that order. It has been found that two protein subunits bind to their own RNA transcript in a unique manner and this ribonucleoprotein complex binds both upstream and

downstream of insertion site (Eickbush 2002). TPRT first begins when the upstream protein subunit endonuclease nicks the target site to expose a free 3' hydroxyl to prime complementary DNA synthesis by the RT domain on the protein (Luan 1993). The upstream subunit then nicks the target DNA and initiates second strand synthesis to complete the integration event. Previous DNase I footprinting studies have revealed

that the two protein subunits, in association with their RNA transcripts, occupy about a 60 base pair span of DNA (Christensen 2004).

It is my intention to further our knowledge of how this protein binds to the DNA target site by using high resolution DNA-protein footprinting techniques. Modifications of DNA included methylation of guanine residues within the major groove of DNA

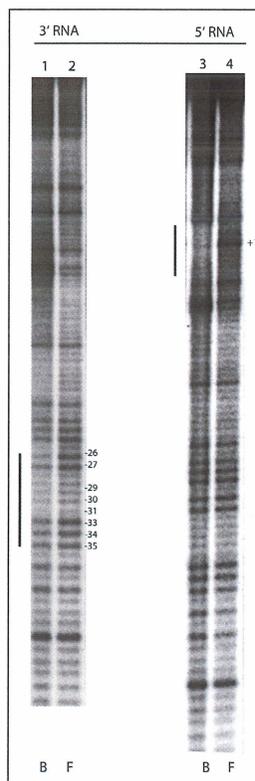


Figure 1: Methylation interference footprint of R2 protein using 3' & 5' RNA on top strand DNA. Contact points on guanine residues at -26, -27, -33, -34, -35, and adenine points at -29, -30, -31 using 3' RNA. 5' RNA shows a guanine contact point at +11.

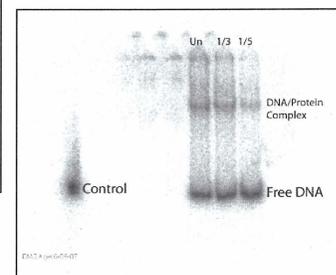


Figure 2: EMSA gel, separation of bound from free DNA on 5% polyacrylamide gel. Amounts of protein used: undiluted, 1/3, and 1/5.

and ethylation of phosphates along the DNA backbone to reveal the DNA-protein interactions. In addition cleavage of DNA by hydroxyl radicals was achieved by production of micromolar amounts of radical species by the Fenton reaction.

#### METHODOLOGY

R2Bm protein was obtained by using an expression vector to produce protein of interest. The protein was then extracted and purified through two columns. The first column used was a Q-Sepharose (ion exchange) column followed by a DNA-cellulose column which captured our DNA binding protein. Fractions were assayed by gel electrophoresis.

Electrophoretic mobility shift assays (EMSA) were performed with the purified protein. Target DNA oligonucleotides were end-labeled and gel purified. The top strand DNA segment used was 120 base pairs long. The sequence is GCTCTGAATGTCAACGTGAAGAAATCAAGCAAGCGC GGGTAAACGGCGGGAGTAACTATGACTCTCTTAAGGTAGCCA AATGCCTCGTCATCTAATTAGTGACGCGCATGAATGGATTA. Radiolabeled DNA was incubated with R2 protein and then loaded onto a native 5% polyacrylamide gel to separate bound from free DNA.

Interference footprints were made by first modifying DNA, then allowing protein to bind DNA, and this complex was subjected to EMSA. The bound and free fractions were isolated and eluted from the gel. Methylation was produced by using dimethyl sulfate in accordance with standard protocols (Struhl 2000). Ethylation was achieved with N-ethyl-N-nitrosourea and hydroxyl radical reaction was performed as described by Wissmann and Hillen in *Methods of Enzymology* (1991).

#### RESULTS/DISCUSSION

Protein extracted from the bacterial expression vector did bind to target DNA revealing that the protein of interest was purified and active. Achieving the correct amount of modification proved difficult; reactions that are over

modified give a biased picture of the cleaved segments of DNA that show the footprint of the protein. Also there was difficulty in having enough radioactively labeled DNA after the various manipulations in order to see the footprint, as the manipulations greatly reduce the signal.

Dimethyl sulfate predominantly methylates the 7-nitrogen of guanine within the major groove and the 3-nitrogen of adenine in the minor groove of DNA. Using a methylation interference assay, results indicate protein binding near guanine residues at -33, -34, and -35, on the top DNA strand and in the presence of 3' RNA. There are also less prominent guanine contact points at nucleotide positions at -26 and -27. Adenine interference positions of the minor groove are located at -29 through -31. In the presence of 5' RNA the protein binds near guanine located at +11 on the top strand.

#### CONCLUSION AND FUTURE RESEARCH

Continued fine-tuning of experimental conditions will soon lead to data from which specific DNA-protein interactions can be interpreted from ethylation and hydroxyl radical interference studies. In addition uracil interference assays will be investigated to identify relevant thymine contact points.

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## Electron Energy Spectrum of CdTe Nanoparticles Using Monochromatized Synchrotron Radiation

AALE NAQVI

Mentor: Alex Weiss, Ph.D. (Department of Physics)

### INTRODUCTION AND BACKGROUND

The research presented details the first steps in studies aimed at testing the hypothesis that nanoparticles (NPs) can be used to selectively sensitize cancer cells so that x-rays may be used to selectively destroy the cancer without harming the surrounding tissues. The ultimate goal of the research would be to develop NPs that could be functionalized for selective uptake by cancer cells in order to promote their destruction by x-rays at doses below those that would cause damage to healthy tissue not containing nanoparticles. Here we report the results of preliminary measurements of the energy spectra of electrons emitted from CdTe NPs under synchrotron radiation performed at the National Synchrotron Light Source. NSLS is a DOE funded facility dedicated to producing synchrotron radiation, electromagnetic radiation produced by accelerating electrons to relativistic speeds along a curved trajectory, at various energies ranging from infrared to x-rays at Brookhaven National Lab [1-2].

### METHODOLOGY

Nanoparticle solutions of CdTe (585nm) were deposited on silicon substrates of approximately 1cm<sup>2</sup> in size after etching the substrates carefully with hydrofluoric acid. The samples were exposed to ultraviolet radiation of varying energy under ultra high vacuum (UHV),  $\sim 10^{-10}$  torr using beam line U16B of the NSLS. After mounting the sample in the chamber, it was subsequently prepared for baking, a process that removes water and similar gases from the chamber, by covering the beam line thoroughly with aluminum foil such that all parts of the foil were in contact with

electrical heating tapes. The electrical heating tape was powered by variable voltage sources which were adjusted on the first day to prevent temperature exceeding 80°C. The temperature was checked every three hours to avoid a temperature gradient across the chamber. During the three day "bake out," the excess gas inside the chamber was pulled out using a turbo molecular vacuum pump. The chamber was allowed to cool and the pressure inside was reduced to  $7 \times 10^{-10}$  Torr upon completion of which the chamber valves were opened to let the synchrotron beam into the beam from the VUV ring.

We performed photoelectron spectroscopy, a technique that probes chemical composition and bonding at the surface by measuring the kinetic energy of the electrons emitted as a result of UV or low energy x-ray irradiation. The chemical information is obtained after the data are analyzed to determine the binding energies of the electrons emitted from the surface through Einstein's equation:

$$KE = h\nu - BE - \Phi \text{ Equation 1}$$

where KE is the kinetic energy of the measured electron,  $h\nu$  is the energy of the incident photons, BE represents the binding energy of the electrons and  $\Phi$  is the work function of the spectrometer.

A series of photoelectron spectra were obtained using a sequence of incident photon energies ranging from 50eV to 240eV. The composition of the surfaces of the NPs and their surfactant material were identified by comparing the binding energy peaks to the binding energies in the X-ray Photoelectron Spectroscopy (XPs) handbook and also observed the fluorescence of the NPs through the chamber

glass to monitor the NP's damage.

## RESULTS AND DISCUSSION

The spectra obtained revealed only the elements: S, Si, SiO<sub>2</sub>, Na, and Cl. These elements are the constituents of the substrate and the surfactant material and not the nanoparticle's core. These results suggest that the surfactant layer is too thick to allow for the emission of the photoelectrons due to the CdTe core of the NPs. We attempted to measure photon-induced damage to the NPs by observing the changes in its spectrum over time; however, we were unsuccessful. We noted that the NPs lost their fluorescence within several seconds, a phenomenon that was physically observed several times at 230eV by varying the sample position. This suggests that the changes caused by photon-induced damage occur on a time scale of several seconds and are thus completed before taking the first spectra. This would explain why further changes were not observed in subsequent spectra. We attempted to observe damage at different energies, but were unsuccessful at finding a densely coated region due to the non-uniform coating on the sample.

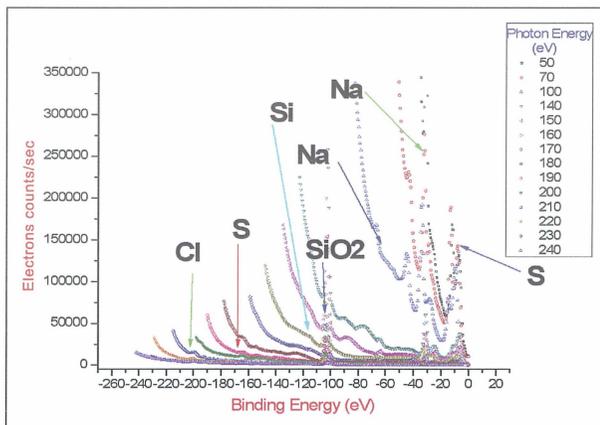


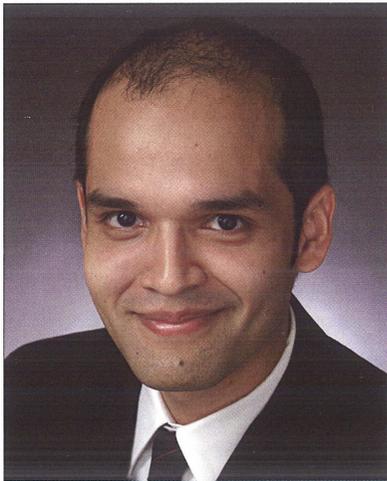
Figure 1: Photoelectron spectrum of CdTe 585nm at various photon energies. Peaks corresponding to photo-electrons emitted from the 2p<sub>1/2</sub> level of Si, the 2s and 2p<sub>3/2</sub> level of S, the 2s and 2p<sub>1/2</sub> level of Na, and the 2p<sub>3/2</sub> level of Cl are indicated by the arrows labeled by their appropriate element.

## CONCLUSION AND FUTURE RESEARCH

Using synchrotron radiation, we identified the surfactant material on the NPs and found that the NPs demonstrated a time-dependent damage response and lost their fluorescence within a few seconds exposure to 230eV photons. The mechanism behind the damage is as yet unknown. We propose two possible damage mechanisms: i. photon-induced local heating and ii. Coulomb explosion. We hypothesize that this later process could be ignited by the Auger cascade process which could lead to the ejection of multiple electrons from an atom in the core of the NPs causing it to explode through Coulomb repulsion. Future research is planned in which uniformly coated NPs films, grown using the layer by layer assembly method, will be used to study the photon-induced damage to the nanoparticles as a function of photon energy and radiation flux.

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## An Examination of the Evolution of Verbal Behavior and the Effects of Extinction Duration on Accelerated Performance Accuracy

JOSÉ GABRIEL SÁNCHEZ

Mentor: Dr. James Kopp, Ph.D. (Department of Psychology)

### INTRODUCTION

It is hypothesized that a preference exists in a concurrent schedule of reinforcement between a multiple and tandem schedule of reinforcement when reinforcement magnitudes are equivalent. This preference will give insight into the evolution of private and public problem solving or non-verbal and verbal behavior, respectively. If positive reinforcement and negative reinforcement work similarly in promoting the reoccurrence of behavior, then negative reinforcement or behavioral momentum should work inversely to positive reinforcement in regard to its frequency of potential reinforcement distribution. It is believed that there exists an optimal extinction time that is species dependant (De Villiers, 1977), and a recoil or oscillation in performance accuracy will become apparent when a variable extinction duration pattern around a relative time interval is implemented. This data would be beneficial to quantitative models of behavior.

### LITERATURE REVIEW

Skinner (1987) defines verbal behavior as any behavior that requires a second individual to act a certain way that prompts a particular response and produces reinforcing consequences. Skinner (1987) theorized that private problem solving is composed of tandem reinforcement schedules and public problem solving is more similar to multiple

schedules of reinforcement. The present study resembles that of Neuringer (1967), in which he used two separate nose-poke keys in a concurrent schedule of reinforcement to successfully measure choice. Domenger & Schwarting (2006) observed that well-trained (i.e. skilled) rats display superior performance under sequential conditions rather than random conditions, namely, faster reaction times and higher response accuracies. This type of research induces the necessity to seek patterns in behaviors relevant to behavior acquisition and learning. Savastano & Miller (200) claim that extinction and preference are assumed to reflect behavioral mass.

### METHODOLOGY

Four female albino Sprague-Dawley rats were used in this experiment. All subjects were placed on food deprivation and maintained at 85% *ad libitum* weight. All subjects were pre-trained, using the shaping procedure and stimulus control, according to basic operant conditioning studies. Rats were either first placed on a MULTFR2 schedule of reinforcement or a TANDFR1FR1 schedule of reinforcement with a 5s extinction period until 50% accuracy for two consecutive training sessions was achieved. These two schedules were to simulate verbal and non-verbal behavior, respectively. The subjects were then paced on their same respective schedule of reinforcement

but with an altered 10s extinction duration, until an 80% criterion of two consecutive schedules was maintained. Following this criterion, subjects were placed on the alternate schedule component until the same criterion was reached. The experimental concurrent schedule featured a new method using variable extinction durations.

#### RESULTS AND DISCUSSION

The purpose of this study is to observe if a preference exists in rats between an unbiased choice of verbal and nonverbal representative schedules of reinforcement. This study also examined the effects of extinction period manipulative effect on behavioral momentum and performance accuracy. There was a clear preference for a tandem schedule of reinforcement over the multiple across three subjects. Both subjects that had received tandem schedule training first advanced much more quickly into the concurrent schedule condition than those first trained in the multiple schedule of reinforcement. One subject did not meet the criteria of pre-training and was not placed in the final concurrent condition. All rats showed improved performance moving from the five-second extinction to the ten-second extinction period during pre-training. The matching principle was inconsistent with the current findings. Implications of variable extinction duration are discussed and a theoretical model of the momentum and density of behavior is suggested.

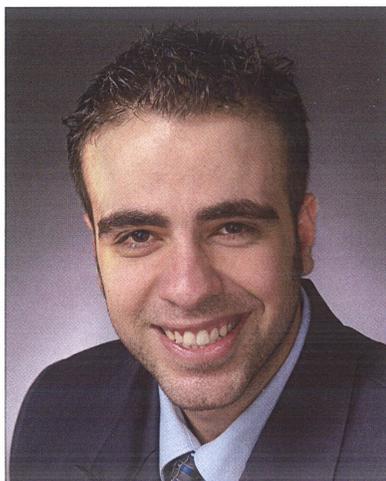
#### CONCLUSION AND FUTURE RESEARCH

The results of this ongoing research are to be considered inconclusive until more evidence is collected. A slight alteration to the previous work by Roark & Kopp (2006) raises many questions concerning both the nature of verbal and nonverbal behavior and the effects of variable extinction rates. The present study adds to the literature

of the discussed concurrent schedule of reinforcement and can possibly serve as a reference in future developments in quantitative behavioral analysis. Currently, a control study of this concurrent schedule's variable extinction rate is being examined and its completion will provide relevant variables to be compared. Future research could involve a direct application of the matching law by modifying tandem schedule's relative rate of reinforcement to reflect that of a multiple schedule of reinforcement and explaining why such a deviation exists. Future studies in variable extinction rates are also viable as well as developments in models of probability and the momentum of behavior.

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## Resistivity and Hall Measurement in Semiconductor Heterostructures

MOHAMMED SALEM

Mentor: Kambiz Alavi, Ph.D. (Department of Electrical Engineering)

### INTRODUCTION

A semiconductor is a material in which the electrical conductivity is lower than that of a conductor and higher than that of an isolator. However, its conductivity can be controlled over a wide range. Silicon is a good example of such a semiconductor. It is the principle component of glass, concrete and cements, and it is widely used in electronics integrated circuits such as computer chips and discrete active devices such as power transistors. A semiconductor heterostructure is basically a multi-layer semiconductor crystal made out of more than one material. Such structures are found mostly in group III-V compound semiconductors such as GaAs, AlGaAs, and InGaP.

The goal of this research project is to apply the techniques of resistivity and Hall measurements, with the aid of mobility spectrum analysis, to determine the conductivity, resistivity, carrier mobility, and carrier density of a semiconductor heterostructure sample, grown by epitaxial methods, with uniform composition and known thickness. These measurements will be performed in the presence of a strong magnetic field at temperatures lower than room temperature.

### LITERATURE REVIEW

The electrical characterization of materials has been very important in scientific research for centuries. It has progressed considerably during the past two centuries, enabling scientists to take innovative measures in utilizing them for practical applications. In the early 1800s, resistance (usually denoted by  $R$ ), and conductance (usually denoted by  $G$ ) were used as fundamental physical

means to determine the characterization of any material. The discovery of the *Hall effect*, the *Quantum Hall effect*, and the *Fractional Quantum Hall effect*, proved to be major breakthroughs in the field of quantum mechanics that have given us further insight into the mechanism of electric charge transport in solids and in semiconductors. At present, there are three major practical uses of these effects: 1) in characterizing multilayer semiconductors, 2) in designing practical devices used as sensors based on the electrical properties of the materials and 3) in setting resistor standards for various materials. For instance, the classical Hall effect has been used for designing automobile accelerometers and the Quantum Hall effect has been used for setting resistor standards by the National Institute of Science and Technology (formerly National Bureau of Standards) for years.

### METHODOLOGY

Two major measurements have been performed in my research, the Hall and the resistivity measurements. In the Hall measurement, current (denoted by  $I$ ) is passed through a sample semiconductor material in the presence of a magnetic field (denoted by  $B$ ), which causes a force (denoted by  $F$ ) to be exerted perpendicular to the directions of both current and magnetic field. This force pushes the negative charge carriers (electrons) to accumulate on one side of the material, leaving the positive charge electrons (holes) to stay on the other side. The asymmetric distribution of charge carriers causes a potential difference across opposite ends of the material, known as the Hall voltage (denoted by  $V_H$ ).

Measuring the Hall voltage  $V_H$  yields a value for the sheet concentration or the number of electrons present per unit area (denoted by  $n_s$ ) using the formula mentioned here:  $n_s = \frac{IB}{qV_H}$

In the resistivity measurement, current (denoted by  $I$ ) is passed through a sample and the voltage (denoted by  $V$ ) across the sample is measured. The measured voltage is dependent on the conductivity and resistivity properties of the material. The conductivity of a material is also related to the mobility of the material. For a square sample of thickness  $d$ , resistivity  $\rho$  is given by  $\rho = \frac{Vd}{I \ln 2}$

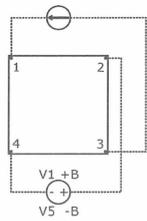


Figure 1: The Hall measurement schematic

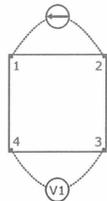


Figure 2: The resistivity measurement schematic

## RESULTS AND DISCUSSION

Using the sheet concentration  $n_s$  and resistivity  $\rho$  found from the Hall and resistivity measurements, respectively, I can derive the formula for Hall mobility (denoted by  $\mu$ ) of the material:  $\mu = \frac{V_H}{V} \frac{1}{B} \frac{\ln 2}{d\rho}$

A MATLAB program written earlier by Charles Kearney, a former UT Arlington researcher, was used to analyze the data from the lab by performing the two measurements. Figure 3 shows the result of mobility spectrum analysis, which describes the behavior of the charge carriers per cubic meter of sample, which is also known as sheet concentration or the charge carrier density (obtained from the Hall measurement) and the Hall mobility (obtained from the resistivity measurement) of a typical heterostructure semiconductor that is subjected to an intense magnetic field. The measurements were obtained from the semiconductor sample PN8237 which was subjected to a magnetic field of 0 to 1 Tesla (10kG). This PN8237 was a two-layer p-n junction diode with one layer of electrons and another layer of holes. The graph clearly shows the highest peak for negative mobility, which corresponds to the negative charge carriers or electrons, and smaller peaks for positive

mobility, which correspond to the positive charge carriers or holes. It is typical to find the mobility of the electrons to be higher than that of the holes.

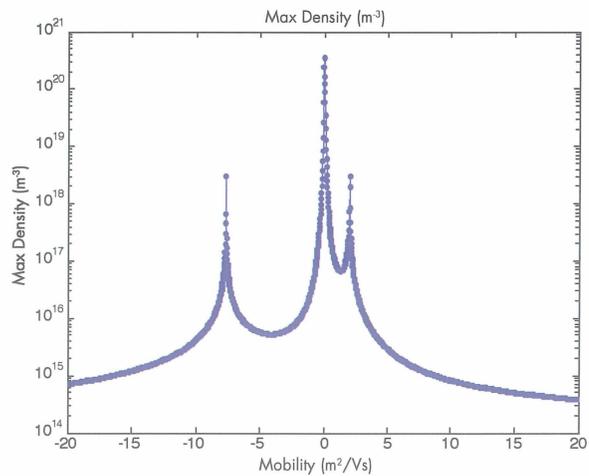


Figure 3: Mobility Spectrum Analysis

## CONCLUSION

Mobility and charge carrier density are important properties of semiconductor heterostructures. Knowing these properties, the semiconductors can be used in many engineering applications like integrated circuit devices, sensors, etc. There are expensive ways of analyzing these properties but I have realized from my research that resistivity and Hall measurements provide very convenient and economical ways to analyze the properties of semiconductor heterostructures.

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## The Effect of Lesions to the Insular Cortex on Fear, Anxiety and Pain Processing

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### INTRODUCTION

The issue of pain has been a topic of interest for centuries and a great deal of effort has been put forth in understanding this process. Pain can be defined as an unpleasant sensation associated with physical and emotional experience and usually is accompanied by a strong desire to stop it (Schnitzler et. al, 2000; Melzack & Casey, 1968). The sensation of pain as it is transmitted from an area of the body to the brain is conducted by a specialized neural pathway known as the nociceptive system. This system detects, processes, and interprets nociceptive stimuli, which are painful or potentially painful, to create the sensation of pain (Raja et al., 1999).

Past fMRI studies have shown the anterior insula consistently activated during experience of pain (Andersson et al., 1997). According to the imaging studies the posterior insular cortex is activated during auditory, visual and somatosensory functions whereas the anterior insula is associated with pain-related activities (Andersson et al., 1997). Additionally, the insula has been shown to effect acquisition of fear responses (Brunzell, et al., 2001; Santini, et al., 2004).

Until recently there has not been much research done on the involvement of the insular cortex in regard to pain processing. This study sets out to examine the involvement of the anterior insular cortex in pain, fear, and anxiety processing. It is hypothesized that lesions to the anterior insular cortex will produce differences in fear, anxiety, and the processing of pain.

### METHODOLOGY

Forty-five male Sprague-Dawley rats were used. All animals were randomly assigned to a condition (sham, unilateral lesion, bilateral lesion) and underwent a standard stereotaxic surgery in which an electrode was inserted either unilaterally or bilaterally into the anterior insular cortex. During surgery, each condition was treated the same; however, lesion conditions received 1.5 mA of current, while the sham condition did not. After a recovery period, each animal was exposed to three behavioral tests: light-enhanced startle, elevated plus maze, and mechanical paw withdrawal threshold testing.

#### *Light-Enhanced Startle*

Rats were placed in small soundproof boxes, which sat on top of a movement-sensitive platform. Speakers located in the back of the apparatus emitted a constant white noise of 65 dB. Animals were randomly presented with varying tones (90dB, 95dB, and 105db) in two phases. The first phase was absent of light; during the second phase lights illuminated the chamber to approximately 900 lux.

#### *Elevated Plus Maze*

Rats were placed on a wooden platform, approximately one foot above the ground, in the shape of a plus sign. Two arms were enclosed and two arms were open, each extending 20 inches outwards. The time spent in each arm and in the center of the apparatus was measured and analyzed using video equipment.

### *Mechanical Paw Withdrawal Threshold*

Rats received an injection of 1% carrageenan (an inflammatory agent) in the left hind paw. Four hours later, mechanical threshold measurements were obtained using the up/down method (Dixon, 1980) with eight von Frey monofilaments delivered to the right hind paw, and then the left hind paw, for approximately 1 second. If there was no withdrawal response, the next higher force was delivered. If there was a response, the next lower force was delivered. This procedure was performed until no response was made at the highest force or until four stimuli were delivered following the initial response.

### RESULTS AND DISCUSSION

The results from the light-enhanced startle test show that the animals reacted significantly to the increment in the intensity of both sound and light. On the other hand there was no significant difference between the animals that received unilateral, bilateral, or sham lesions. The data obtained indicated that damage to the insular cortex may have little direct influence on fear processing.

The results from the elevated plus test revealed that the animals spent most of their time in the enclosed arms. Furthermore, there was no significant difference in behavior between the animals that received unilateral, bilateral or sham lesions. The lack of movement towards the lit area was an indication that the rats' level of anxiety was not altered by lesions to the insular cortex.

The results of the mechanical paw withdrawal threshold testing were not significant either. Rats with lesions of the insular cortex did not show behavior that deviated from the sham animals after they underwent the mechanical hypersensitivity threshold testing. This leads one to conclude that the lesions to the insular cortex did not increase or decrease the animals' pain threshold.

### CONCLUSION AND FUTURE RESEARCH

This study was intended to promote further understanding of the insular cortex and its function by using electrolytic lesions. Although previous studies have implicated the insular cortex in playing a significant role in pain and anxiety processing, the results obtained did not confirm that. This warrants further investigation, which is crucial in achieving a better understanding of the insular cortex. As new studies emerge it is becoming apparent that the insular cortex is more complex than previously known. These findings greatly contribute to future studies in pain and anxiety related issues such as chronic pain, which is a serious physical and mental problem in the United States today (Gatchel, et al., 2007). Such advances in insular research have the potential to bring about more effective therapies in pain and anxiety management in the future.

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## The Benefits of Timely Rehabilitation after Spinal Fusion Surgery

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### INTRODUCTION

Spinal fusion is a surgical technique of last resort, performed to eliminate pathophysiology related to impaired motion of the spine. There are several reasons to perform a spinal fusion, including: deformity, disc herniation, fractured vertebra, and chronic pain with motion. The hypothesis of this study was that post-surgical fusion patients would have comparable outcomes to the general population of injured workers who had not had such surgery, provided that the fusion patients were actively involved in proper interdisciplinary rehabilitation in a timely fashion. Outcomes were objectively assessed by evaluating one-year post-rehabilitation socioeconomic outcomes that included work return and work retention.

### LITERATURE REVIEW

Spinal fusion is a very controversial surgical technique because outcomes vary among individuals, as well as due to the high medical cost, frequent utilization, and presumed limited effectiveness (Mayer, McMahan, Gatchel, Sparks, Wright, & Pegues, 1998). Techniques have been developed to assess the physical and mental well being of the surgical candidate in order to maximize selection of the ideal patient. These methods aim to optimize successful post-surgical recovery. Extensive rehabilitation programs are in place to assist patients on their way to recovery.

### METHODOLOGY

#### *Participants*

A prospective cohort study involving a consecutive cohort of 2,114 patients with chronic disabling spinal disorder, and 383 patients with at least one fusion, who underwent a tertiary rehabilitation program were compared on objective socioeconomic outcomes after treatment. All patients were totally or partially disabled before admission to an intensive, medically supervised, functional restoration program, combining quantitatively directed exercise progression with a biopsychosocial pain and disability management approach. Socioeconomic outcomes were obtained at a one-year post-treatment interview. The objective of the study was to evaluate whether post-surgical fusion cohorts, based on time of entry into the functional restoration program, would have outcomes comparable to the general population of non-surgical injured workers with spinal disorders. Patient demographic data, such as gender, age, ethnicity, medical history, and various socioeconomic factors were obtained from patients' medical and evaluation charts.

#### *Design and Procedure*

One-year post-rehabilitation socioeconomic outcomes were collected using a structured telephone interview. Socioeconomic outcomes included variables such as work return and work retention. All patients were enrolled in a functional restoration program at Productive Rehabilita-

tion Institute of Dallas for Ergonomics (PRIDE), and had consented to the collection of data for the purposes of rehabilitation management and research.

#### Data Analysis

The Chi-Square test statistic was utilized for all analyses of categorical variables when evaluating differences among the four groups. Additionally, a test for a linear trend was conducted to determine if poorer socioeconomic outcomes were associated with longer time elapsed from surgery to rehabilitation. For each categorical variable evaluated, simple pair-wise comparisons of each fusion group against the non-surgical group was conducted, using a logistic regression with the groups as the predictor variable; inflation for Type I error rates were controlled using a Bonferroni adjustment. A one-way analysis of variance across all groups was conducted on all continuous variables. For each continuous variable evaluated, Dunnett's test was used to compare each fusion group against the non-surgical group.

#### RESULTS AND DISCUSSION

Table 1 presents Chi-Square analyses of the one-year socioeconomic outcomes which revealed an overall group difference on work return and work retention measures. Also, pair-wise comparisons revealed that a time lapse of two or more years between surgery and rehabilitation was significantly associated with a lower percentage of work return (89% vs. 73%;  $p < 0.05$ ) and work retention (82% vs. 64%;  $p < 0.05$ ). The fusion group receiving rehabilitation within one-year of fusion surgery was the only group

showing a significant difference in treatment-seeking rates, relative to the non-surgical group (23% vs. 36%;  $p < 0.05$ ). The fusion group receiving rehabilitation within one-year following surgery was observed on mean number of visits to a new healthcare provider, compared to the non-surgical group (3.68 vs. 2.04;  $p < 0.05$ ). The hypothesis was supported by the results, with the demonstration that shorter time lapse between surgery and rehabilitation was associated with one-year occupational outcomes that were comparable to the non-surgical group.

#### CONCLUSION

In conclusion, spinal fusion surgery outcomes vary greatly due to the lack of standardized objective measure of the outcome following fusion surgery, as well as the lack of research that pairs fusion surgery with adequate post-surgical rehabilitation.

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**Table 1. One-Year Socioeconomic Outcomes of Program Completers (N = 2129)**

Variables	Non Surgical Cohort N = 1830	F Within 1 Year N = 158	F 1 - 2 Years N = 82	F 2 or more Years N = 59	P Group / Linear
Work Return [% (n)]	89.2 (1465)	82.5 (118)	82.4 (61)	73.1 (38) *	.000 / .194
Work Retention [% (n)]	82.8 (1351)	76.9 (110)	74.3 (55)	63.5 (33) *	.001 / .077
Seeking Treatment [% (n)]	22.6 (383)	36.1 (52) *	33.3 (25)	35.7 (20)	.000 / .878
Mean visits (SD)	2.04 (5.51)	3.68 (7.55) *	3.61 (7.95)	2.98 (5.94)	.001 / .552
New Surgeries	1.9 (33)	2.8 (4)	2.7 (2)	3.6 (2)	.747 / .793
New Injuries [% (n)]	2.6 (42)	1.4 (2)	2.7 (2)	3.8 (2)	.772 / .287
Case Settlement [% (n)]	95.1 (1643)	93.2 (137)	96.1 (73)	94.6 (53)	.737 / .561



## Literature Review of Adolescent Postpartum Depression and Posttraumatic Stress Disorder following Childbirth

JENNIFER WILLIAMS

Mentor: Cheryl Anderson, R.N., Ph.D., C.N.S. (School of Nursing)

### INTRODUCTION

Although teenage pregnancy rates have been declining over the past decade, pregnant adolescents still comprise a large subgroup of the population who share common risk factors (Saewyc, Magee, & Pettingell, 2004; Klien, 2005). Additionally, "by 2010, the population of adolescent girls 15 to 19 years of age is expected to increase by 10%; thus, decreasing pregnancy rates may not mean fewer pregnancies or births" (Klein, 2005, p. 284). On occasion, the traumatic event of childbirth culminates in an acute stress reaction followed by posttraumatic stress disorder (PTSD) and postpartum depression (PPD). Although there is a growing body of research for postpartum depression, there is limited research on PPD among adolescents. Research concerning adolescent PTSD, especially related to labor and delivery, is virtually nonexistent and in critical demand. The purpose of this paper is to review available literature for gaps in knowledge regarding PTSD and PPD among adolescents following childbirth.

### LITERATURE REVIEW

A significant population of teenagers face labor and delivery, as well as additional family and social stress, including a large portion with a history of physical or sexual abuse, all of which puts them at risk for acute stress disorder (ASD), PTSD, and PPD. Sexual abuse removes

boundaries and distorts views of sexuality, which may lead to increased risk behavior and subsequent increased risk of pregnancy. Childbirth has been found to be traumatic among adult women, and PTSD has been researched for adult women following childbirth with an incidence reported of 1.5-2.8% (Creedy, Shochet, & Horsfall, 2000; Ayers & Pickering, 2001). However, postnatal PTSD has not been described for a vulnerable adolescent population. PTSD is linked to consequent development of PPD, often accompanied by anxiety and mother-infant bonding difficulty. PPD is reported in 7-13% of the adult population (Georgiopoulos, et al., 1999; Beck, 2001; Bloch, Rotenberg, Koren, & Klein, 2006), but commonly reported to be as high as 50% in adolescent populations (Deal & Holt, 1998; Miller 1998). Despite the dramatic increase in incidence of PPD or potentially higher rates of PTSD, the adolescent population has not been addressed sufficiently as to childbirth consequences or psychological sequelae.

### METHODOLOGY

To generate the literature review, current relevant studies were located for adolescent and adult PPD and postnatal PTSD, measurement tools and sample sizes were noted, and findings reported. Location and selection of sources was predominantly completed in the UTA library and

online. Studies selected were academic in nature, almost exclusively retrieved from peer-reviewed journals, and literature included in the review was determined by relevancy. Methods of assessment and data collection used by the researchers in the studies were identified, and the outcomes of the selected studies were described.

#### DISCUSSION

Review of the available literature demands continuing research, including large randomized samples that may be applied to the general population of adolescents, with cultural and economic considerations. Not only do differences between adult and teens need to be addressed, but developmental differences demand that there will be a distinction in the cognitive processing of labor and delivery, and therefore the disease process of ASD, PTSD, and PPD, by younger adolescents (13-15 years old) versus older adolescents (17-19 years old). Incidence, along with risk and protective factors, of ASD needs to be addressed in the adolescent population, and, therefore, there remains a critical need for research to explore adolescent PTSD and the link of adolescent ASD to PTSD and PPD. Healthcare assessment often focuses on the signs and symptoms of PPD of adolescents (and adults), commonly missing the presence of PTSD due to several common, overlapping indicators. Additional research is required to support the need for assessments of the often-overlooked diagnoses of ASD and PTSD, especially following childbirth among adolescents.

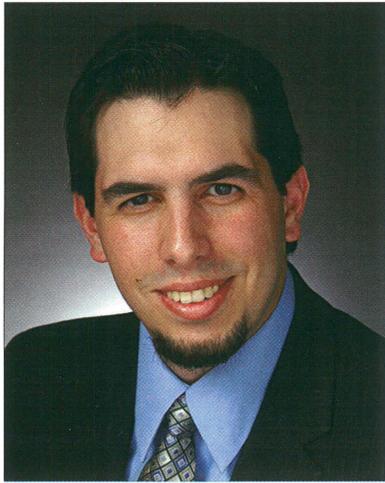
#### CONCLUSION

The process and effects of these disorders in adolescents has not been addressed in published literature, but is currently being studied by Dr. Cheryl Anderson at the University of Texas in Arlington. The current study addresses

the adolescent population, overlooked even though a much larger percentage is vulnerable to these disorders than adult mothers. This significant study will pioneer research in the areas of adolescent postpartum ASD and PTSD, and supplement and expand previous findings for adolescent PPD. The data collected on the postpartum adolescents over the course of Dr. Anderson's study will be utilized to help future teenagers deal more effectively with labor and delivery and new motherhood. A list of adolescent PPD and PTSD risk factors may evolve from this research shaping the care of pregnant and laboring teens, aiding nurses and counselors in identification of those who are most at risk so they might be offered more intensive teaching and counseling services before they reach the point of ASD, PTSD or PPD. Longer term follow-up services may need to be set in place for these high-risk young women.

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## Horizontal Transfer of Genetic Material: The Transposable Element Content of Viruses

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### INTRODUCTION

The purpose of this study is to understand the extent to which viruses play a role in the horizontal transfer of transposable elements by surveying the presence of transposable element proteins contained in viral genomes. Endeavors were made to identify all eukaryotic transposable element proteins encoded for by viruses utilizing sequence data stored in international databases such as Genbank at NCBI and Repbase at GIRI. Since transposable elements are portions of an organism's DNA that are capable of replication and translocation within a host genome, they are prime targets for horizontal transfer because they have the capability to extract themselves from the host genome and be taken up by the recipient genome [1]. The recipient organism in this study is the virus. The role of the virus in delivering genetic material to other organisms has been previously discussed, but their role as the vectors for and intermediaries in the process of horizontal transfer has never been elucidated. This investigation aims to identify viruses as participants in the mechanism of horizontal transfer as both recipient organisms and intermediaries, and it strives to lend credence to the concept of viruses as vectors for the horizontal transfer of genetic material between organisms. Further investigations can then be performed to identify the mechanism and biochemical pathway for the uptake of DNA by the virus, a better understanding of the translocation of DNA from the viral vector to the recipient organism, and, possibly, the refinement of current transgenic techniques.

### LITERATURE REVIEW

Evidence of the horizontal transfer of transposable elements has been identified in the organism *Drosophila melanogaster* in natural populations. It has been shown that the *P1*, *hobo*,

*gypsy/gtwin*, and *jockey* element families of transposable elements must have entered the organism's genome at some recent period by horizontal transfer because the element is not present in laboratory sub-groups that have been in isolation from the natural population for that period of time (approx. 40-70 years based on the element family in question) [5, 2, 9, 4, 3, 6, 7, 8]. These studies provide evidence of horizontal transfer of transposable elements.

### METHODOLOGY

The first stage of this project required that the genomes of known viruses be compared to the sequences of known transposable elements. To accomplish this, viral genome sequences were acquired from the Genbank database at the National Center for Biotechnology Information (NCBI). Only those viral genomes that have been sequenced and submitted to NCBI were available for analysis. Transposable element sequences were acquired from the Repbase database from the Genetic Information Research Institute (GIRI). Repbase contains those eukaryotic transposable elements whose genomes have been sequenced and submitted to the database. Once the viral and transposable element sequences were collected it became necessary to formulate a database for each set of data. The two databases were then compared using BLAST in order to identify possible sequence homologies.

The second stage of the project involved the identification of viruses carrying transposable element proteins from among the results of the BLAST comparisons. This was accomplished by first eliminating all non-significant results ( $e\text{-value} < 10^{-3}$ ), identifying viruses with possible transposable element proteins, and aligning those proteins with consensus sequences from transposable elements. All results with an insignificant

e-value ( $< 10^{-3}$ ) were culled from the data sheet. Next, the alignment of each result with a significant e-value was analyzed to determine the nature of the sequence homology. Those sequences that remained were then analyzed using bioinformatics tools at NCBI to search for conserved domain architecture and to identify similar domain architectures located within the NCBI databases. Those sequences that displayed conserved domains found in transposable element proteins but not viral proteins were then analyzed again using the BLAST program at NCBI and the alignment programs Clustal and GeneDoc. This time the putative transposable element proteins were aligned to conserved domain sequences from transposable elements found at Repbase.

The final stage of the project involves identification of the transposable elements that underwent horizontal transfer into the viral genomes and will utilize phylogenetic analysis methods to provide evidence that the putative transposable element proteins identified in the viral genomes did descend from transposable elements. Alignments procured from the Clustal and GeneDoc programs and conserved sequences from related transposable elements were analyzed using Mega3.1 to determine phylogenetic relationships.

#### RESULTS AND DISCUSSION

By surveying the presence of transposable element proteins contained in viral genomes, this study aimed to understand the extent to which viruses play a role in the horizontal transfer of transposable elements. It has been found that transposable elements experience horizontal transfer events that result in their integration in viral genomes, and very strong evidence has been provided illustrating that viruses with embedded transposable elements can serve as vectors for horizontal transfer events between two separate organisms.

#### CONCLUSION AND FUTURE RESEARCH:

##### *A Source for Biodiversity and Genetic Novelty*

The horizontal transfer of transposable elements and other genomic material provides a source of biodiversity and genetic novelty in both viruses and the organisms they infect.

An example is the reticuloendotheliosis virus (REV, a Class 1 LTR element) embedded in the genome of the Fowlpox virus (FPV). Data provided by the investigators [10] indicated that the virulence of FPV is subject to the presence or absence of REV in its genome. When REV is present FPV is more virulent and vice-versa. This is one example of horizontal transfer providing for biological diversity in nature. In more complex organisms it has long been theorized that many genes have been acquired by gene capture events from transposable elements. If this is the case then an organism with novel transposable elements such as those acquired by horizontal transfer events has a greater opportunity for the capture of novel genetic sequences and increasing its overall biodiversity. Regardless, this study has demonstrated that the horizontal transfer of transposable elements occurs with a much greater frequency than previously documented, and can, therefore, provide a nearly inexhaustible source of genetic material for the diversification of an organism's genome.

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## McNair Scholars & Staff 2007 Events and Activities

