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Volume I

2008-2009

The St. Mary's University McNair Scholars Program

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Contents

Introduction

It is my great pleasure to offer this introduction to the first volume of the St. Mary's University McNair Scholars Research Journal (STMU-MSRJ). This journal represents the hard work and determination of the inaugural class of St. Mary's scholars who completed these projects during the summer of 2008. Each of these students was selected to participate in the federally funded McNair Program because of their motivation to pursue doctoral study and their strong academic potential. The McNair Scholars Program was funded by Congress to honor Ronald E. McNair, the American astronaut and physicist. The ultimate goal of the program is to increase the diversity of those holding doctoral degrees. With this in mind, St. Mary's scholars are drawn from among students who are traditionally underrepresented and from across the university community. Scholars include students from the schools of Humanities and Social Sciences, Science, Engineering and Technology, and the Bill Greehey School of Business. Nine different majors are represented with each scholar completing research on a distinct topic with the help and guidance of a dedicated group of mentors and program staff. Ultimately, however, these projects are important as the first offerings of our next generation of American scholars, our first glimpse of works by authors whose ultimate potential remains in the future. It is my hope that you enjoy these works and find many future opportunities to follow the scholarship of this gifted group of students.

- Jennifer Zwahr-Castro, PhD
Director, St. Mary's University McNair Scholars Program

Wasted Time, Lost Lives, A Possible Solution

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Abstract

The problem of searching for missing persons is directing considerable attention to the possibilities that a Global Positioning System, (GPS), and Radio Frequency Identification, (RFID), device could actually be useful to detect someone who is lost or in danger. Both of these devices are distinct yet they could be capable of preventing the loss of life and money. A software program can be created to provide information given by the GPS device and the RFID reader.

Introduction

Over the past twenty five years, reports of missing people have increased from nearly 150,000 in 1980 to 900,000 this year. It has been estimated that about 2,300 American adults and children are reported missing every day, which includes both adults and children. Trying to find a missing person can be stressful for the family members who have a loved one missing but also those involved in the search. Through their emotional distress, questions are raised as to whether officials act upon the information they have given. As one father stated, "Police tell you nothing about what they are doing with your case and tips, but we know the results. NOTHING." Sadly, many don't know how to deal with these situations. [11]

On Saturday, June 21, 2008, the bodies of three missing snowboarders were finally found by friends near Crystal Mountain in Washington State. The three men, Kevin Carter, age 26, Devlin Williams, age 29, and Phillip Hollins, age 41, where confirmed missing since December 3, 2007. The Pierce County Sheriff's Office called off the search after about a week, but friends continued the search where they believed they could have been until they located the tent where they were found. So, the three missing snowboarders were finally found by friends and not by officers after about seven months. [13]

Could there be a solution to this type of problem? Is there a way to find someone missing in only a few minutes using a reasonable amount of money to find them and perhaps save a person's life?

GPS is a wide-area tracking system. Applications include the military coordinating the movement of troops and supplies, allowing accurate targeting of various military weapons such as cruise missiles and precision guided munitions, and aiding in mapping. Not only can this system be beneficial to the military, but also for civilian use. GPS has been used in cars, boats, and almost any other vehicle to track its specific location. On-star by General Motors, GM, uses GPS to track vehicle whereabouts and allows the user to summon emergency help or to ask questions. [1][3][12]

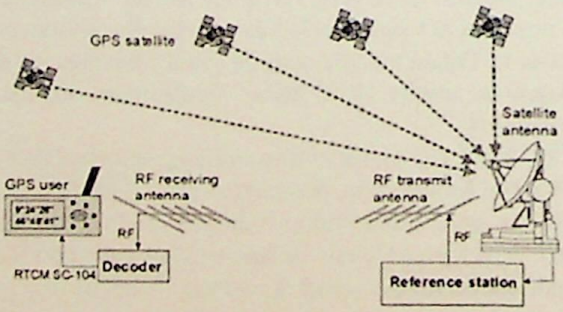
RFID is a confined area monitoring system. Its uses include retail stores to monitor and control inventory supply at all times, chips that are implanted under an animal's skin to provide the information and history of the animal, and in hospitals so that patients, or doctors can be located quickly. This last application provides controlled access to certain drugs and areas of the hospital that are considered to be restricted. [7][8]

These devices are being used everywhere for different purposes. Even though these are two distinct systems, they could be used as a packaged system for customers to rent at a water resort or cruise. In case of an emergency in which the individual goes missing, rescuers could quickly and efficiently locate the missing person.

What is a GPS Device?

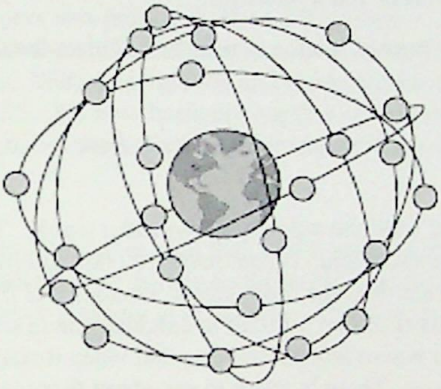
The Global Positioning System, GPS, is a satellite navigation system. It uses a constellation of twenty four satellites that transmit precise microwave signals to GPS receivers. This enables these devices to accurately determine current speed, direction, location, and time.

A satellite constellation is known to be a group of satellites working in concert to provide information for one specific purpose. These group of satellites work together to coordinate with ground coverage, each under shared control. This means that there are ground stations that monitor the system. A receiver such as a computer containing a special type of program will be able to detect the signals sent from the satellite and also be able to send information back using the source code implemented. So, the user has to create some kind of software program that will communicate with digital hardware. These satellites will be synchronized, containing an internal clock, so that the information sent from the receiver and the transmitter will overlap well rather than interfere with other satellite coverage. In other words, the Disaster Monitoring Constellation, which provides emergency Earth imaging for disaster relief, would not want to interfere with signals sent from Galileo, a global navigation satellite system built by the European Union.



Determining the correct values. [2]

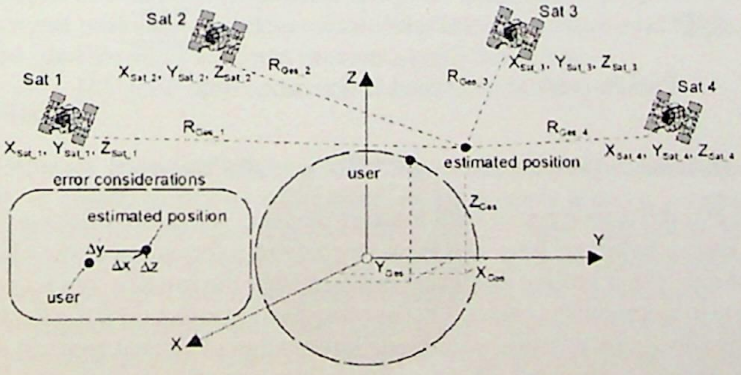
There are numerous kinds of constellations and GPS is one of them. It is the U.S. global positioning system that calls for twenty four satellites that are distributed equally among six circular orbital planes. Each satellite has several atomic clocks on board and contains frequencies that operate at 10.23 megahertz. Microwave signals transmitted are electromagnetic waves that range from 1 millimeter to 1 meter in length, or frequencies, defined as a number of cycles per unit time, between three hundred megahertz and three hundred gigahertz. Current ground stations, also known as the "Control Segment", are located in Hawaii, Ascension Island, Diego Garcia, Kwajalein, and Colorado Springs. These stations monitor both their operational health and their exact position in space. They can transmit corrections for the clock offsets and ephemeris constant, a list of positions or locations of a celestial object, the satellite, as a function of time, back to the satellites themselves.



Satellites among orbital planes. [4]

How Does GPS Work?

The basis of GPS is triangulation. Triangulation is defined as the process of finding coordinates and the distance to a point by calculating the length of the side of a triangle. By knowing the length of the three sides of the triangle by a certain point and the measurements of the angles, the law of sines could be applied to find out the distance to a point; this is also known as trilateration.



Calculating distance using satellites. [2]

$$R_{Ges\_i} = \sqrt{(X_{Sat\_i} - X_{Ges})^2 + (Y_{Sat\_i} - Y_{Ges})^2 + (Z_{Sat\_i} - Z_{Ges})^2}$$

Cartesian system used to calculate distance from the object to the satellite. [2]

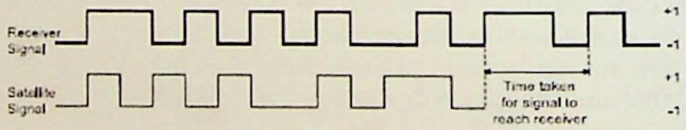
The GPS receiver is able to calculate the distance from its position to the satellite. By intersecting three spheres such as the one shown on the figure above, one could determine the receiver's position. For better accuracy, four satellites can also be used to determine the objects position.

How is Distance Calculated to Each Satellite?

One of Isaac Newton's laws of motion is used to calculate the distance to each satellite.

Distance = Velocity x Time

Velocity could be found from the velocity of the radio signal. The speeds of radio waves are as fast as the speed of light. It can travel 290,000 kilometers per second. Time would be considered to be the time the radio signal would travel from the satellite to the GPS receiver on earth. This could be difficult to calculate since scientists would have to calculate the time the radio waves left the satellite and when it reached the receiver; this is possible and could be done. There is much to say about these signals and what they do. Briefly, the satellite has two signals modulated upon it. The C/A code or the Coarse/ Acquisition code and the P-code or the Precision Code are the names of the two signals. The Coarse/Acquisition code is a digital code that is pseudo-random. This term seems to define this signal as information that is output random but in actuality it is not. The same code can in reality repeat one thousand times every second. Time in a C/A code is based on a very accurate atomic clock. Like this code, the receiver contains a clock that is used to generate a matching C/A code. Through this process, the receiver can correlate with the incoming satellite code and timing could then be calculated.



Pseudo-random code used to determine time delay. [4]

What is the Difference Between Active and Passive GPS Devices?

There are two different types of GPS tracking devices. An active tracking GPS device, also known to be real time, can view coordinates information as the object is moving. Not only can it receive its current position from the satellite, but it can transmit its information to a computer system. On the other hand, passive GPS are the kind of systems we usually know of where coordinate information of current position are recorded and a set time is provided. When plugging into a computer, its data will represent where the receiver was situated during certain times.

GPS Facts

History

Over the years, there has been different ways that have been approached to define a specific location and diverse tasks have been made to simplify navigation and positioning. Such ideas were placing landmarks as to remembering where the Big oak tree was on the side of the road, "celestial" such as looking upon the stars at night like Syrius and finding your way to your destination, LORAN a terrestrial radio frequency navigator generally for coastal purposes, and many others. It was not until after World War II, the U.S. Department of Defense decided upon getting a better method to obtaining a more precise navigation system. A solution for the problem of inaccurate positioning had to be made. For example, they needed to create a device that could detect the exact position of the enemies' missiles and destroy them with a perfect hit. It wasn't until the beginning of the 1970s that a new project was proposed; The GPS system.

Originally, GPS was designed for military use. But, it was clear that this device could also be used for civilians. Marine navigation and surveying became the first two major applications that used GPS. We now basically see this system everywhere. They are used in automobiles, airplanes, boats, and a wide range of different other uses.

Limitations

GPS cannot be used indoors. It is vital that a GPS antenna has a clear view to at least four satellites. Sometimes satellite signals could be blocked from being perceived by the receiver when a large tree or building is in the way. The system should be used outdoors.

Current Uses

The Global Positioning System has several applications for both military and civilian use. Notably, military GPS mechanisms are considerably more accurate than a regular civilian GPS device. This is because the government did not want civilians to have perfect accuracy to a location, so Selective Availability (S/A) was required. S/A provides an offset of a few feet of the actual position. But, in spite of this, civilians can use this type of technology for navigation when they are in their automobiles, airplanes, while riding a bike, for marine networking, and can be found mostly anywhere nowadays. These utilities are now being implemented into cell phones so that if there is an emergency and 911 is dialed, they could automatically detect their location fast and easy.

For the military, this navigation system has been a great benefit for soldiers. It can allow them to find object in the dark and coordinate the movement of troops. Pilots can also be found fast and permits them to accurately hit a target using special kind of weapons such as cruise missiles. There are many more numerous amounts of applications that GPS could be used for and I have just mentioned only but a few.

What is RFID?

Radio Frequency Identification is an automatic identification method. It can automatically identify an object, collect its information, and then apply it into a computer system program. RFID was first developed in the 1980's and has since been known to have the capabilities to track a moving object, unlike a bar code. Enabled readers can capture the data on tags and transmit it into a computer without a person being involved.

For the purpose of identification using radio waves, these tags have been applied to animals, objects, and persons. Basically, these chips contain an internal circuit as memory to retain any information about the user, and an antenna that will receive and retrieve frequency signals from a transceiver, which is another separate antenna that can collect

the user's information and then apply it into a computer. The key part of this technology is that these tags don't need batteries and can last for many years, maybe even decades.

The scanning antennas of a transceiver can be permanently fixed to a surface such like a door frame. When this is done, whenever a person, object, or animal containing a transponder, the tag, passes through this door, its data will be accepted. Essentially, when a RFID tag passes within frequency range of the receiver, the chip reacts to this signal and in effect will transmit its information.

There are three types of RFID tags. Active tags have power systems that contain batteries with a frequency of 915 MHz that can be read from a distance of a hundred feet or more. Passive tags can be completely powered by incoming RF signal and can last longer than an active tag. The last type of tag is called the Semi-passive tag; it contains a battery like an active tag but can still use the reader's power to transmit a message back to the RFID reader using a technique called backscatter. This procedure is the reflection of waves or signals back to the direction they came from.

What Does This System Contain?

- Silicon chip
- An antenna
- Some kind of housing as a cover
- Tags themselves
- RFID readers
- Computer network that is used to connect the reader
- Radio modulator for sending a response back to the reader
- Control logic
- Amount of memory
- Power system

Control Logic

This term is defined as part of a software architecture that controls what the program will do. The instructions set in the program are translated into binary through the "decoder unit" and then passes its information to the control logic location.

RFID Facts

History

A device invented by Leon Theremin is considered to be a predecessor of the RFID technology. It was created to detect sound, using radio frequency. This was in 1946, but in 1939, the IFF transponder was invented by the United Kingdom. This transponder receives signals and then amplifies it and retransmits the signal back; it is still now used today by the military to track if other vehicles or aircraft are friends or foes. It was not until Mario Cardullo in 1973 introduced the true ancestor of the RFID technology.

Limitations

RFID's are local. This system basically consists of a tag/transponder, reader/transceiver, and the infrastructure or the computer software. The reader can only read from one inch to a hundred feet or more depending on the frequency added; the larger the frequency range, the larger the distance applied. But, it is limited to only a certain range, unlike the GPS device which is global.

Possible System Solutions

There may be possibilities to being able to combine GPS and RFID systems together into one program. They are two distinct devices, yet they could be used for the same purpose of locating a missing person. The Global Positioning navigation device can function globally to provide specific coordinates of the person containing the receiver and a Radio Frequency Identifier is only limited to function in a local area. Although one is global and the other local, a software program can be created to coincide the information given by each technology. By this, if for some reason a person cannot be found using a GPS when outdoors, there would be a likely chance that this person may be indoors and perhaps be found by the help of an RFID. For example, if these two different systems were to be applied or used at water park resort for the benefit of the customer and the park itself, a missing person could be easily located and found. In other words, a customer would have the option to purchase a packaged deal containing both GPS and RFID just in case a family member like a child or himself would get lost in the park and could be used to track. RFID receivers could be put into operation in every local store, room, or any enclosed area in the park. This could then be helpful to receive the information given by the RF tag the person may have; the tag could be placed in a bracelet or a necklace so that it could be worn by the user. When this transponder (the tag) is activated such like when entering into a store, information is passed to the transceiver such like the name of the person and the time they arrived and left. Not only does it have to contain the name and the time, but other information such as the total amount of money wasted where spare change or actual money is not necessary. Parent could also add information strictly not allowing their children buying candy or any other items anywhere in the park. The computer system would simply not allow these products to be purchased. Also, the GPS device would be useful to see the person's whereabouts in real time, meaning a map could be brought up from a software program to locate and identify the object as it is moving from place to place. In addition to this, these devices could not only be used at a water park, or a ski resort, but at a cruise. A GPS could also contain alarm as a small component within itself. By having this benefit, if a person for some reason goes overboard on a cruise ship, the alarm could be set off as soon as it gets in contact with saline water. There has been many times where we have heard that people have gone missing on a cruise ship, perhaps gone overboard, and nobody even noticed. But, with an alarm implemented into the GPS, this could advice the cruises supervisors to take notice and take action to stop the ship and find that person who just fell off into the water. Again, as I have stated before, this packaged system could definitely save life's not wasting time locating them, and money. Insurance companies and other major organizations or recreational areas managing these places could certainly save money.

How Would This Work?

In order for a computer receiver to obtain the persons exact location they are currently in, there are various steps to consider. Simply, its receiver will synchronize with the satellite, which will then calculate the position using triangulation. The satellite will then send back the results to the receiver, where it will display the degree angles and coordinates. This information will then be sent to a computer program; its capabilities would be to see the actual coordinates plotted on a map. In this map, the object containing the GPS will be seen in real time as it is moving. An active GPS chip, led display, a board, and the programming code are needed to create a GPS system. For an RFID, on the other hand, the actual tag, the transponder that detects the tag using some kind of microprocessor, and the code placed into this tag are needed as well. Now, to combine these two devices, a

software program should be created to receive the information given by both the GPS and the RFID.

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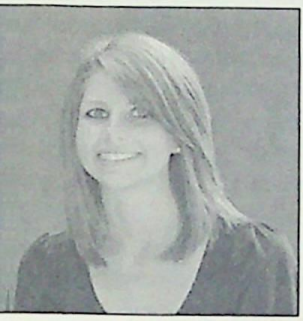
Exploration, Object Play, and Secure-Base Use in Two Beluga Calves



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Abstract

Young animals are known for their playful conduct with a variety of stimuli. Stimuli may include their primary caregiver, similar-aged conspecifics, other species, and inanimate objects that are native or foreign to their natural environments. In species with extended offspring care, the mother-offspring relationship becomes an important factor in the exploratory behaviors exhibited by the young animal. The current study investigated the types of exploration, including object play, motor play, and social interactions displayed by two beluga calves in the care of humans at Sea World San Antonio during their first nine months. The study also examined the calves' use of their mothers as secure bases from which to explore. Although the calves spent the majority of their time with their mothers, they also engaged in a variety of exploratory play, including orients at novel and familiar objects, manipulations of different objects, and motor play. The activities generally increased over the nine months, but fluctuated during times of calf illness. Finally, the calves appeared to use their mothers as secure bases or as safe havens while engaged in motor play or social interactions. The calves' secure-base use indicated that they have formed bonds that were specific to their mothers and that the bond mediated their exploratory behaviors.

Exploration, Object Play, and Secure-Base Use in Two Beluga Calves

The formation of attachments as the result of extended care and parent-infant interactions in humans continues to be of extreme importance. Much of the current research on attachment has returned to its ethological roots and has explored the bonds of non-human animals, particularly those who maintain long term mother-infant associations. One set of animals in which attachments have yet to be formally examined are cetaceans, such as bottlenose dolphins and beluga whales. Many cetaceans are known to have particularly

strong mother-calf relationships and thus are likely to have bonds that may qualify as attachments.

As bonds, attachments are the enduring relationships between young children and their mothers or caregivers, which develop from their interactions with each other over time. Attachment behaviors are behaviors that create and strengthen the bond, which is unidirectional, at first (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1969). Attachment behaviors include crying, orienting, acting out, making motions, or moving toward the mother, all of which draw the caregiver's attention towards the infant. These efforts by the infants are intended to resolve an internal state elicited by some perceived stressor. Thus, attachments provide children with physical and psychological security through the mother or attachment figure.

The presence of attachments and their characteristics have been empirically documented and identified in humans and several other animal species. Using a series of separations and reunions of infants from their caregivers in a laboratory-based technique, Ainsworth and her colleagues (1978) were able to investigate differences between mother-child relationships. As outlined in Table 1, the strange situation consists of eight episodes with increasingly stressful situations.

Table 1
Summary of Episodes of the Strange Situations

Number of Episodes	*Persons Present*	*Duration*	*Brief Description of Action*
1	Mother, Baby, & Observer	30 sec.	Mother & baby introduced to experimenter room by observer, then observer leaves
2	Mother & Baby	3 min.	Mother waits while baby explores
3	Stranger, Mother, & Baby	3 min.	Stranger enters. Stranger gradually approaches baby, then stranger leaves again
4	Stranger & Baby	3 min. or <	First separation episode. Mother leaves, Stranger interacts with baby
5	Mother & Baby	3 min. or >	First reunion episode. Mother greets/ comforts baby, then leaves
6	Baby alone	3 min. or <	Second separation episode
7	Stranger & Baby	3 min. or <	Stranger enters and interacts with baby
8	Mother & Baby	3 min.	Second reunion episode. Mother enters, greets baby. Stranger leaves

The purpose of the strange situation procedure is to determine if children are capable of balancing exploration and attachment needs and how they use or interact with their attachment figures during episodes that might elicit stress (Goldberg, 2000). Exploratory behaviors involve the child moving about an environment to actively examine toys or

new people. Essentially, children must be comfortable enough to venture away from their attachment figure to investigate their environment. In contrast, when children become distressed they will lessen their exploratory play and engage in attachment behaviors to elicit assistance or comfort from their caregiver.

Each episode of the strange situation consists of opportunities to explore and experience anxiety-inducing stimuli. For some children, exploration may be mediated by the caregivers' presence (Ainsworth et al., 1978). When children are away from their caregiver while exploring, they may orient at their caregiver, decrease proximity to their caregiver, return to their caregiver, or touch their caregiver while engaged in play. These behaviors are thought to maintain the children's comfort level so that they may continue to explore. Known as secure base behavior, children view their caregiver as a security blanket from which to explore novel environments and stimuli.

When the distance, physical and psychological, between caregiver and child is too great, the caregiver has left the room, and/or a stranger is present, many children experience a measurable increase in anxiety and distress. This tension typically results in the activation of attachment behaviors and the use of the caregiver, if present, as a secure haven. Secure haven occurs when children are actively engaged in exploratory behavior but become frightened by some stimulus and return back to their caregiver (Ainsworth et al., 1978). While secure base activates exploratory behaviors, secure haven elicits attachment behaviors through fearful stimuli. When fear becomes stronger than the desire to explore, attachment needs will cause children to move away from the fearful object and back to the caregiver (Ainsworth et al., 1978). Although children are seeking comfort from their caregiver, they do not have to remain in close proximity once contact and comfort has been obtained. Thus, exploration may return quickly.

The strange situation is used to ascertain how children respond to the novel environment when their caregiver is present or absent. It is also used to examine the children's responses to the separations by and reunions with their caregiver. By examining the patterns of responses, Ainsworth and her colleagues (1978) identified three basic attachment types: securely attached, insecurely attached-avoidant, and insecurely attached-resistant. Securely attached children seek a moderate level of proximity to their caregivers and are genuinely upset by their departures and greet her upon a reunion. Insecurely attached-avoidant children are generally unaffected by the presence or absence of the caregivers and disregard them when they return or leave. Insecurely attached-resistant children are very upset when their caregivers leave, but when they return the children seek comfort while also resisting it (Schaffer, 1996).

Although attachment theory (Bowlby, 1969) was intended to explain human behavior, its foundation lies in animal behavior. In the last decade, many researchers began re-examining attachment theory and it tenants within non-human animal relationships. For example, the strange situation has been adapted to investigate the relationship between dogs and their human companions (Prato-Previde, Custance, Spiezio, & Sabatini, 2003; Topal, Miklosi, Csanyi, & Doka, 1998). The human-dog relationship is similar to the parent-child relationship. Dog owners often tend to view and care for their dogs as if a child (Topal et al., 1998). Dogs also seem to view their owners as a child might under certain circumstances. For example, dogs attempt to engage and maintain their owner's attention during interactions. Specifically, dogs show attention-seeking behaviors and display exhilaration when their owner returns (Prato-Previde et al., 2003). The tendency for humans and dogs to reciprocate each other's emotions could inadvertently lead to the formation of an emotion-based bond. Thus, dogs' apparent preparedness for forming bonds with humans strongly suggests that attachments are likely (Topal et al., 1998).

Two studies recently explored the possibility of attachments between humans and

dogs. Topal et al. (1998) analyzed the greeting displays of dogs during their owner's return and the appearance of a stranger. Behaviors examined included proximity-seeking behaviors, contact-seeking behaviors, and contact continuance behaviors exhibited by the dogs towards the owner and stranger. The dogs appeared to use their owners as secure bases as the dogs increased their exploration and played more frequently in the presence of the owners as compared to the outsider (Topal et al., 1998). In contrast, Prato-Previde et al. (2003) suggested that the findings of Topal and his colleagues may have been a function of the relationship between the dog and human but not necessarily an attachment. The results of their follow-up study, which used more stringent attachment criteria, indicated that the dogs did not engage in individual play more in the presence of the owner as compared to the presence of a stranger. Thus there was not sufficient evidence to determine that an attachment existed between the dogs and their owners. However, they did concur with Topal et al. in that dogs do appear to exhibit some secure base use and attachment behaviors toward their owners.

Other likely species to display attachments are elephants, horses, kangaroos, and cetaceans, such as bottlenose dolphins. Bottlenose dolphins (Tursiops spp.) are highly social and live in a fission-fusion social system. Thus, individuals associate in groups that can change in composition daily or hourly (Connor, Wells, Mann, & Read, 2000). One exception to this highly variable composition is the group containing mothers and their calves. Females with calves compose one of the most stable and long-lasting social units found in cetacean associations. The mother-calf bond is essential to infant survival and may last anywhere between 3-10 years both in wild and captive dolphins (Cockcroft & Ross, 1990; Connor et al., 2000; Reid, Mann, Weiner, & Hecker, 1995). It is during this first year of dependence that calves acquire important social and physical skills, especially during the first month. The extended period of offspring care is characterized by the calf's increasing independence until the calf is weaned and ready leave the mother to join a different age-based group (Connor et al., 2000).

As most of their time is spent with their mothers during the first year of life, most of the calves' social interactions occur during the mother's presence. The first month is especially critical for the calf. The newborn calf has trouble swimming initially after birth. This difficulty is facilitated by the calf positioning itself at the mother's side continuously while swimming together (Cockcroft & Ross, 1990; Gubbins, McCowan, Lynn, Hooper, & Reiss, 1999; Mann & Smuts, 1999). Swimming together allows the mother to monitor her calf's position relative to her while also monitoring the environment around them (Cockcroft & Ross, 1990; Connor et al., 2000). Most of the first few weeks are spent swimming in "echelon" position, where the calf is at the mother's side, around her dorsal fin region (Gubbins et al., 1999). By the second or third month, calves' generally swim in the "infant" position, where the calf is located under the mother with his dorsal fin near the mother's abdomen in constant contact. These positions allow the mother to better monitor her calf's swimming, position, and safety. As calves grow stronger and learn to swim more efficiently, they gradually become more independent. This independence is characterized by separations and reunions that increasingly become the responsibility of the calf.

In the wild, separations from the mother during this susceptible period occur typically when the mother is foraging. It is very important for the calf to learn to successfully navigate separations and reunions with their mothers and other individuals within the group. Much like humans, sound is regularly used to facilitate the separations and reunions between dolphins (Connor, 2000). Separations in dolphins may be voluntary, such as when the calf leaves the mother to interact with other calves or juveniles, or involuntary, such as when the mother and calf are separated by humans or by other animals. Voluntary

separations can be initiated by both the mother and the calf or by only the calf or only the mother. During voluntary separations, the calves are generally quiet during the beginning of the division but will begin whistling upon reunion (Connor et al., 2000). This pattern of whistling suggests that whistles may be used as a signal to the mother that the infant is ready to reunite (Connor et al., 2000) and may be interpreted as an attachment behavior.

In contrast, involuntary separations elicit very different behavioral states and responses for both mothers and calves. During more traumatic situations or separations, such as restraint by humans or separations caused by aggressive acts or predators, whistles are produced by mothers and calves and are more frequent and of greater intensity (Connor et al., 2000). Involuntary separations also occur when the mother swims in one direction and the calf goes in another direction. Like crying and verbalizations made by humans, whistles in dolphins are important because they relay the location, identity, and level of distress of the dolphin in need (Connor et al., 2000).

Dolphin mothers also communicate with their calves through the use of "thunks." Thunks are low frequency sounds of short duration that are thought to signal disciplinary actions towards the calf. Mothers use these vocalizations when their calves voluntarily venture away from them when the calves are supposed to remain with them (McCowan & Reiss, 1995). Essentially, these thunks are used to ensure that their calves maintain proximity to them, and if not, they are used as a corrective action to sustain proximity.

Although most of our knowledge regarding mother-calf relationships comes from research conducted on bottlenose dolphins, belugas (Delphinapterus leucas) also display behaviors similar to those observed in bottlenose dolphins. Like dolphins, belugas are social and interact with a variety of individuals (Defran & Pryor, 1980). They also have similar social groupings such that mothers, their calves, and other offspring are usually grouped together (Krasnova, Bel'kovich, & Chertnetsky, 2006). Belugas also have extended offspring care, which suggests that a strong mutual bond may exist between them

Very few formal studies of beluga mother-calf relationships currently exist. One of the few studies did report on the development of spatial relationships in beluga mothers and calves in their natural environment (Krasnova et al., 2006). Beluga mother-calf pairs were observed in various swim positions and patterns for nine months. Thus, calves were often found at distances of no more than 1.5 m from the mother, distances between 1.5 to 5 m, and at 5 m or more away from the mother. They were also observed to maintain echelon and infant positions, similar to many dolphin species. In general, the calves were usually found in close proximity to their mothers during the first few months. As they developed though, the calves began to stray away from their mothers, swim independently, and engage in interactions with other calves more frequently.

For example, during the first month of life, calves follow their mothers as the calves are still learning to swim steadily and coordinate their bodies (Krasnova et al., 2006). Voluntary separations by the calves were infrequent during this first critical period as all of their energy was spent on maintaining proximity to their mothers and remaining safe. Thus, their independent learning experiences are few and short in duration (Krasnova et al., 2006). When in danger, the calves were observed to return back to their mothers and remain in an infant or echelon position for some period of time. This behavior is indicative of an attachment that may have formed between mother and calf.

By the end of the first month, the calves were observed to engage in more "play" behaviors such as swimming on their backs or jumping out of the water (Krasnova et al., 2006). They also increased the number of voluntary separations from their mothers in order to initiate interactions and contact with other beluga calves and adults. However, most of their time involved swimming with their mothers.

Month two marked much greater independence for the beluga calves as they required

less assistance from their mothers (Krasnova et al., 2006). As the calves grew older, their lungs became stronger, with increases in breath-holding time. With this physical maturation, opportunities for social development increased as the calves could remain away from their mothers for longer periods (Krasnova et al., 2006). Again, the calves continued to spend the majority of their time alongside their mothers during this month. However, if other calves were spotted, the calf left for a short time to interact with them (Krasnova et al., 2006). Although the calves were becoming more independent, they still maintained proximity to their mothers.

The relationship between beluga mothers and their calves appear to have many of the characteristics that would qualify it as an attachment: extended care, multiple interactions, and a need for safety and protection. The purpose of the current study was to determine whether belugas, in the care of humans, demonstrate aspects of attachment. We hypothesized that 1) beluga calves can form attachments to their mothers and use them as secure bases, which can be seen through their non-fearful exploratory play or social interactions, and 2) beluga calves form attachments to their mothers and use them as secure havens, which can also be seen through exploratory play or social interactions, involving fearful stimuli.

Method

Subjects and Facility

Two beluga mother-calf pairs at the Sea World San Antonio Adventure Park in San Antonio, Texas served as the subjects for this study. MAR, who was one of the mothers, was 25 years of age and weighed approximately 1200 pounds. TIN, the other mother, was also 25 years old, and weighed approximately 1200 pounds as well during the study. The beluga calves are half-brothers. OLI, TIN's calf, was born on June 23, 2007 and currently weighs approximately 270 pounds. GRA is MAR's calf and was born on June, 26, 2007 and currently weighs about 350 pounds. Although both calves are currently one year old, their first nine months were examined for this study.

The calves were born and housed in the Viva show pool, which is approximately 25 feet deep. During their second week of life, the two mother-calf pairs were relocated to a pool in the zoological area of Sea World, 56 ft x 35 ft x 20 ft with a 3 foot ledge surrounding the pool on three of the sides. This move allowed Sea World animal care and training staffs to more closely monitor their behaviors and feeding over the course of the nine months. The beluga pool was adjacent to a smaller holding pool, which gave access to a larger pool housing several bottlenose dolphin mother-calf pairs.

Both the mothers and calves received medicinal and nutritional supplements during feeding sessions through the nine-month period. OLI, who is TIN's calf, received supplements several times a day, everyday, due to a recurring illness. The administration of the supplements involved a short catch and release procedure of each animal. Each procedure typically lasted 3-8 minutes.

Procedure

Archival video data were examined for this study. Generally, 15 minute focal follows of each mother-calf pair were recorded with a JVC MiniDV handheld camcorder or a Canon MiniDV ZR200 handheld camcorder twice a week from two to ten months. The total number of video sessions for TIN and OLI were 52 and for MAR and GRA, there were 56. The total number of minutes for the entire video collection was 763.5 minutes.

The videos were coded for a variety of behaviors but secure base and secure haven responses were primarily targeted. Secure base behaviors required the calf to initially be

swimming and exploring at a distance at least 1-5 m or more away from his mother. This initial behavior could then be followed by one of the following behaviors: an orient in her direction from across the pool, a decrease in proximity to his mother by swimming closer to her, or a decrease in proximity that resulted in actual contact before resuming exploratory behavior.

Exploration was defined as any behavior that began as a calf-initiated separation from his mother and resulted in an active swim and examination of different aspects of his environment. Two broad categories of exploratory behavior included play and affiliative social interactions. Exploratory play was subdivided into motor play, which included behaviors that were high energy, repetitive acts that occurred while moving throughout the environment, and object play, which involved touching and manipulating various aspects of the environment. Affiliative social interactions involved the calf interacting with another beluga or human within the environment in a playful manner. The interaction may have been reciprocated or received by the other participant. An example of an affiliative interaction included the situation in which the calf joined the other mother-calf pair and actively swam together. Table 2 further defines specific exploratory behaviors.

Exploratory behaviors could only occur during independent excursions in which an anxiety-provoking situation or stimulus was not apparent. Thus, the first experience with any stimulus, object, or scenario was not coded for secure-base behavior as it is likely novel events would have provoked some degree of anxiety in our subjects. The calves' experiences to various events were well-documented and thus, novel experiences could be ascertained. If an anxiety-provoking event occurred, then it was expected that attachment behaviors would be observed. Attachment behaviors were defined as responses to potentially alarming stimuli or situations (as judged by the observer and/or coder) in which a calf, who was away from his mother, returned back to his mother and remained in proximity to her no more than 1-2 m away. This safe haven response is one of the hallmark attachment behaviors in humans and was considered critical for belugas as well. Safe haven responses were expected to occur in situations involving novel stimuli or anxiety-eliciting events such as the catch and release procedure used to administer food and medicine. An example in which a safe haven response could occur is that in which the calf joined another mother-calf pair and the mother aggressed toward the initiating calf.

Data Analyses

All dependent variables were transformed into rates by dividing each frequency by the session time. These transformations allowed the data to be compared across sessions. Several composite variables were then created of individual behaviors: object play, motor play, and social interactions. Object play was created by adding the following transformed variables together: fish play, buoy play, spitting water, or pushing. Motor play was computed with water play, slide out, solo swims, and rubbing the wall or floor, and affiliative social interactions included contact with another individual, swimming with another individual, or mouthing.

Duration data were also transformed by dividing the duration of each event by each session time. This transformation produced the overall percentage in which the behavior was engaged for the session. Thus, a 15-min session in which the mother-calf swim (mc swim) lasted 15 min indicated that mc swim accounted for 100% of the session.

Finally, to analyze secure base use and safe haven use by each calf, the transcripts of each session were assessed for the presence and absence of one of those events within motor play, object play, and social interactions. Thus, a calf could potentially have used his mother as a secure base within all three contexts as well as a safe haven within all

Table 2
Operational Behaviors and Exploratory Play

Category	Operational Definition
Motor Play	
Fast Swims	Animal circles the pool at a speed faster than typical swim speed
Rub wall/floor	Rubs the wall or floor with his body, fluke, tail, or mouth
Slide Out	Pulls his body onto the slide out to rub or engage in play
Water Play	Water is repetitively displaced by some body part, including the mouth, pectoral fin, or flukes
Aerial	Animal's body leaves the water and bends over or turns sideways, re-entering the water head or side first
Spiral Swims	Animal rolls body like a barrel while swimming
Tail Slaps	Animal slaps the water with the tail flukes
Solo Swims	Animal actively swims alone, frequently changing direction and orienting at objects
Object Play	
Pushing	Animal uses mouth, body, or fluke to move objects around pool
Jumping	Some portion of the animal's body clears the surface of the water
Spitting	Animal releases water from mouth
EED Interactions	Ex. Playing with buoy balls
Fish Play	Tossing, spitting, biting at fish
Social Interactions	
Contact	Animal rubs or bumps another animal
Mouthing	Animal bites, nibbles, or uses mouth on another animal
Swim with other	Animal swims with animal other than mother or calf

Note. EED stands for Environmental Enrichment Device.

three contexts for each session. Each event was also coded as present or absent. This coding scheme did not account for the frequency with which these events may have occurred within a session, nor did they consider the types of attachment behaviors performed to be coded as a secure base or safe haven event. Nine new variables were created to perform these analyses.

Results

Descriptive Analyses

Table 3 summarizes the mean rates (M) and standard error of the means (SEM), collapsed across nine months, for each variable of interest as well as the mean durations for mom-calf swims, solo swims, and swims with others. Observed object play included novel play with buoys, novel and familiar play with fish, and familiar play with water and the camera. Object play involving environmental enrichment devices (EED) was limited to buoy balls in month 5 during the nine month study. Observed motor play included slide outs, rubbing walls or the floor, and solo swims. In summary, most exploration was self-initiated with fish, water play, or beaching on slide outs.

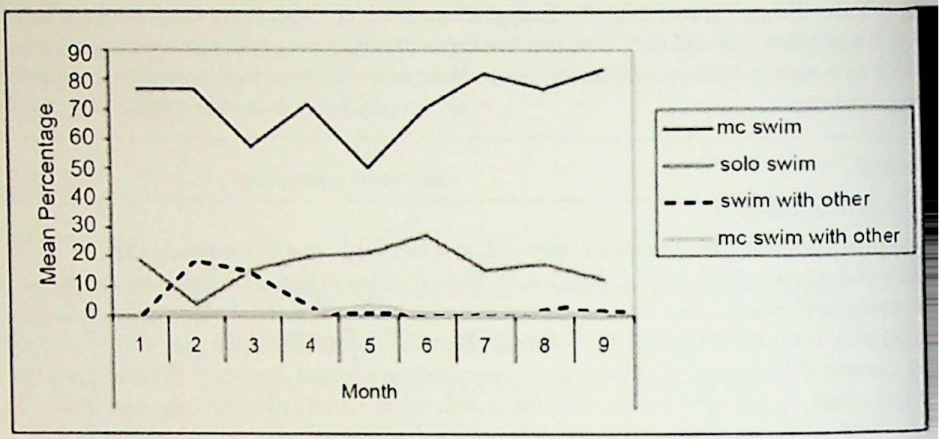
Table 3
Descriptives for Variable of Interest Collapsed Across Nine Months for Each Calf

	GRA	OLI
	M rate ± SEM	*M rate ± SEM*
Exploratory		
Object Play	.010 ± .008	.013 ± .004
Motor Play	.310 ± .097	.407 ± .039
Affiliative Interaction	.106 ± .046	.133 ± .021
Leave	.094 ± .032	.137 ± .017
Attachment Behaviors		
Orient	.010 ± .006	.026 ± .018
Mom contact	.008 ± .006	.024 ± .006
Decrease Proximity	.014 ± .006	.070 ± .041
Return	.081 ± .023	.152 ± .029
MC swim	.183 ± .025	.230 ± .016

Developmental Trends

The developmental trends of major calf activities were examined with 1-way Analysis of Variances (ANOVA) for repeated measures. As seen in Figure 1, no clear trend emerged for the percentage of time mc swim, solo swim, swim with other, and mc swim with others occurred across the nine months. Although OLI and GRA began to decrease the amount of time they swam with their mothers during the first five months, they both increased time with their mothers the last few months of the study. This increase in mc swim corresponded to bouts of illness experienced by each calf.

a. OLI



b. GRA

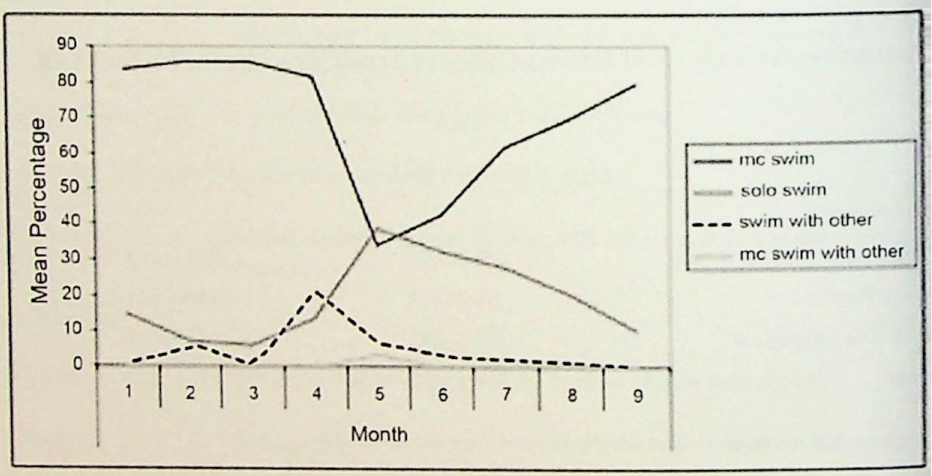
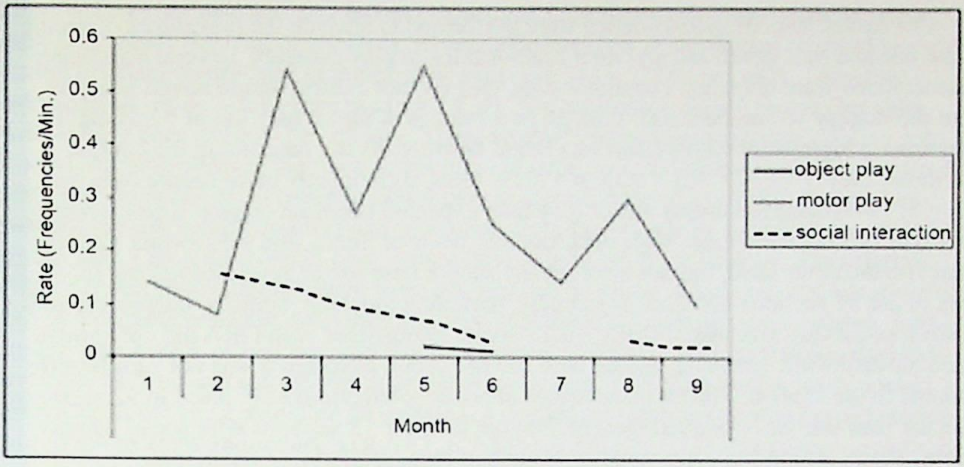


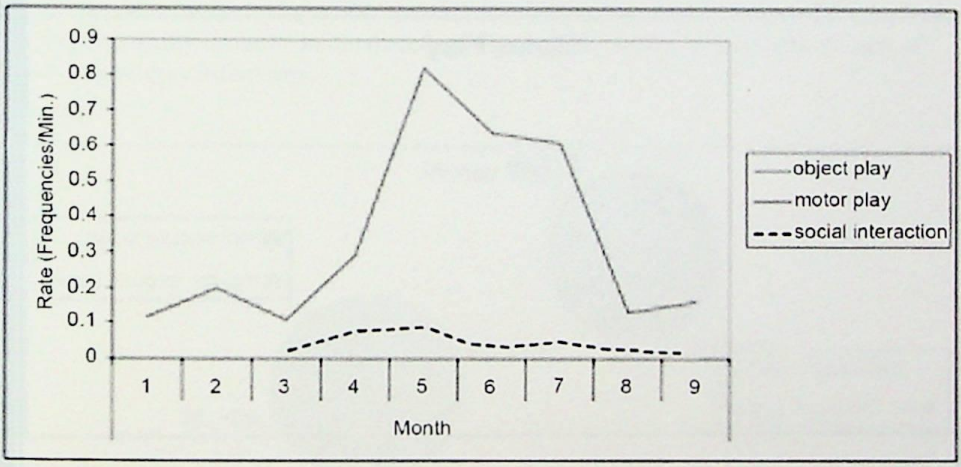
Figure 1. The duration of mother-calf swims (mc swim), solo swims, swim with other, and mother-calf swim with other (mc swim with other) for each individual calf over the course of nine months. The addition of all types of swim should account for 100% of the average session time for each month.

Figure 2 depicts the developmental trends for the mean rates of object play, motor play, and social interactions for each individual calf. One-way ANOVAs for repeated measures indicated that a significant effect for time was found for both motor play ($F(8, 24) = 2.75$, $p = .026$, partial $\eta^2 = .478$) and social interactions ($F(8, 24) = 3.39$, $p = .01$, partial $\eta^2 = .531$) for OLI and for object play ($F(8, 16) = 5.72$, $p = .002$, partial $\eta^2 = .741$) for GRA. Contrast analyses indicated that the trends were best explained by quadratic functions: OLI - motor play ($F(1,3) = 5.96$, $p = .092$) and social interactions ($F(1, 3) = 13.57$, $p = .035$); GRA – object play ($F(1, 2) = 5.30$, $p = .148$). No clear trends were observed for object play exhibited by OLI or for motor play and social interactions engaged in by GRA. However, curve analyses indicated that the developmental trends fo GRA were best explained by quadratic functions, motor play ($F(1, 2) = 19.83$, $p = .908$, partial $\eta^2 = .741$) and social interactions ($F(1, 2) = 19.83$, $p = .018$, partial $\eta^2 = .964$).

a.. OLI



b.. GRA



Figgure 2 The mean rates of object play, motor play, and social interaction are displayed for each individual calf acrross the first nine months.

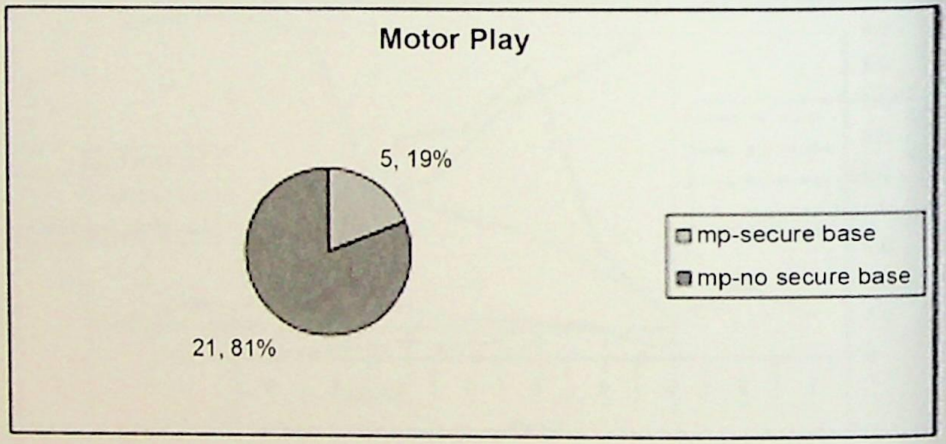
Correlations between Exploratory Behaviors

The relationships between categories of exploratory play correlations including object play, social interactions, and motor play were also explored. No relationship existed between motor play and object play for OLI. However, a direct relationship was found for motor play and object play for GRA, $r\,(N = 56) = .268$, $p = .046$. Thus, more motor play was associated with more object play. Similarly, no relationship was found between object play and social interactions for OLI while one existed for GRA, $r\,(N = 56) = .388$, $p = .003$. Again, greater object play was associated with more frequent social interactions. Finally, a direct relationship was found between social interactions and motor play for both OLI, $r\,(N = 52) = .609$, $p < .001$, and GRA, $r\,(N = 56) = .610$, $p < .001$. Thus, the more social interactions engaged in by the calves, the more likely they were to also engage in motor play.

Secure Base and Safe Haven Analyses

Chi square tests of independence were performed to analyze the prevalence of secure base use and safe haven use and their relationships to play category. Several significant associations were revealed. For motor play, OLI did not exhibit secure haven behavior but did display secure base use. With 26 occurrences of motor play out of 52 available sessions, a significant relationship was found between secure base use in the context of motor play, χ^2 (1, n = 52) = 5.53, p = .019. Thus, significantly more secure base use (n = 5, 19%) occurred during motor play than expected based on chance. These events occurred during water play, slide outs, rubbing walls or floors, and solo swims. Object play, on the other hand, did not result in any secure base use or secure haven use for OLI. Six of the 52 sessions involved object play, including touching, spitting, interacting with buoys, or playing with fish. Finally, OLI's social interactions with GRA did not involve safe haven events. However, secure base use did occur, although it was not significantly related to the context. Fifteen occurrences of social interactions took place in 52 sessions. Secure base use was observed once (6.7%) out of those 15 sessions with social interactions. Figure 3 shows the percentages of each of these exploratory behaviors.

a. OLI



b. OLI

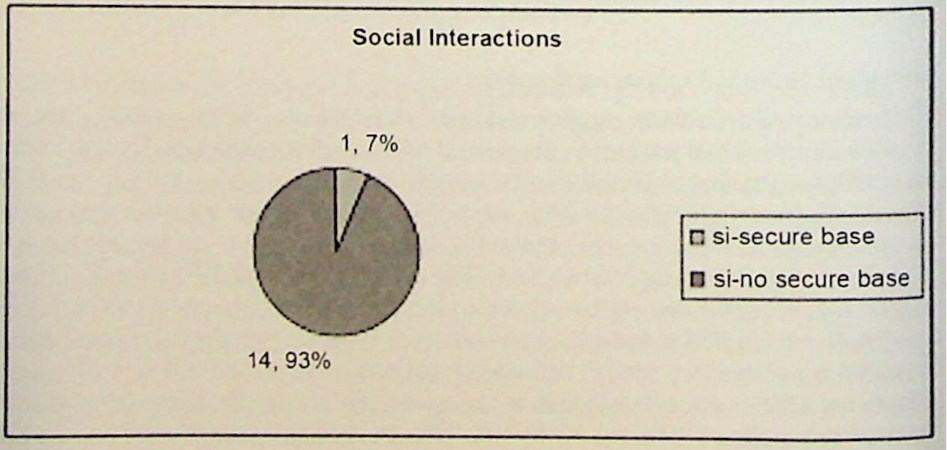
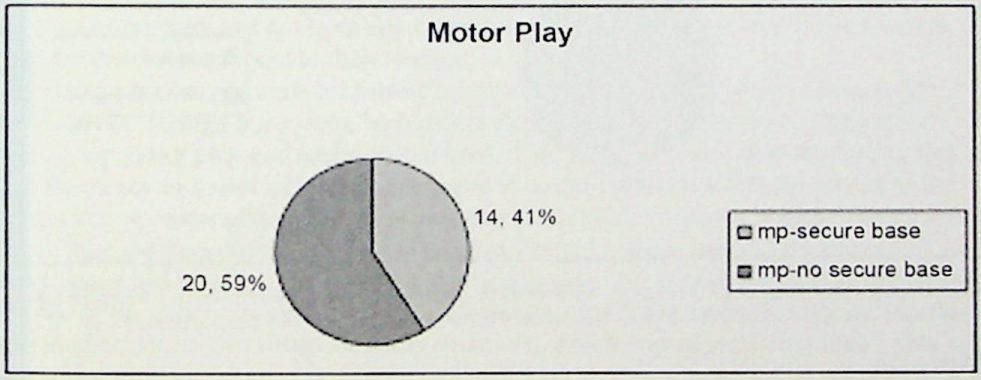


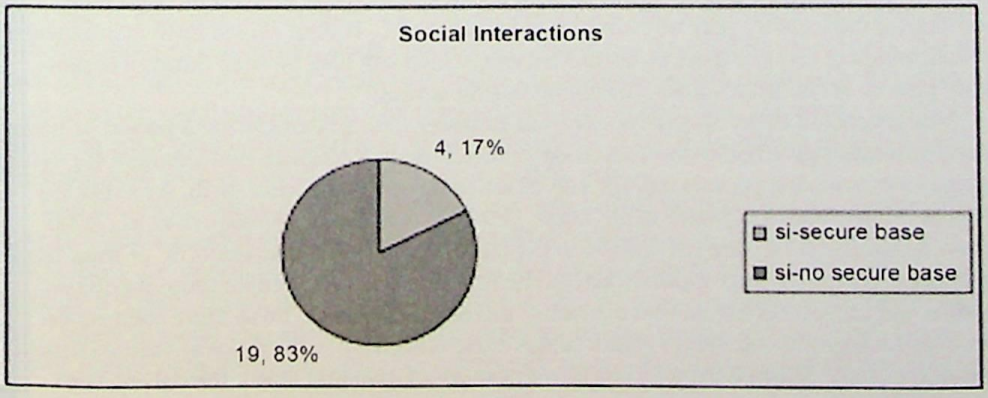
Figure 3. Oliver's secure base use over the nine month period for both motor play (a.) and social interactions (b.). There was no secure base use during object play.

Significant relationships were also revealed in GRA's play categories. During motor play, both secure base and safe haven characteristics were found. There were 34 occurrences of motor play out of a total of 56 available sessions. A significant relationship was found between secure base in motor play, χ^2 (1, n = 56) = 12.08, p = .001. Therefore, considerably more secure base use (n = 14, 41.2%) took place during motor play than would have been expected by chance. These secure base instances occurred during solo swims, rubbing walls or the floor, water play, or slide outs. Safe haven use also occurred, with one event out of 34 possible motor play sessions. When this safe haven event appeared, the calf sought comfort and protection from the mother by immediately returning to her side. Like OLI's object play, secure base or safe haven use did not occur during GRA's object play although there were six sessions in which object play did occur out of the 56 available sessions. Activities included rubbing and touching gates, spitting, interacting with buoys, or playing with fish. In contrast, GRA's social interactions provided both secure base and safe haven characteristics as well. With 23 occurrences of social interactions out of an available 56 sessions, a significant relationship was found between social interactions and secure base, χ^2(1, n = 56) = 6.18, p = .013. Therefore, a significant amount of secure base use (n = 4, 17%) occurred during social interactions than could have been predicted based on chance. Safe haven use also occurred once during the 23 social interactions involving GRA and OLI and TIN. GRA quickly returned to MAR after TIN agonistically oriented in his direction. Figure 4 shows the percentages of each of these exploratory behaviors.

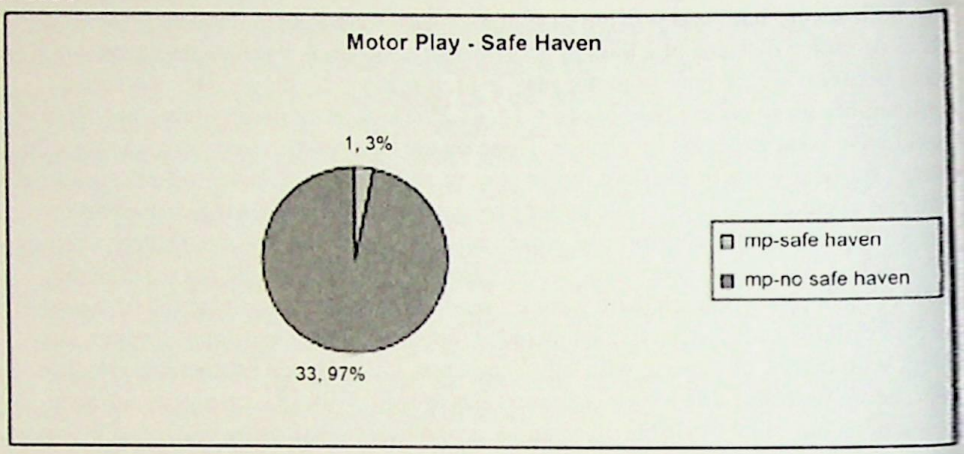
a.. GRA



b.. GRA



c. GRA



d. GRA

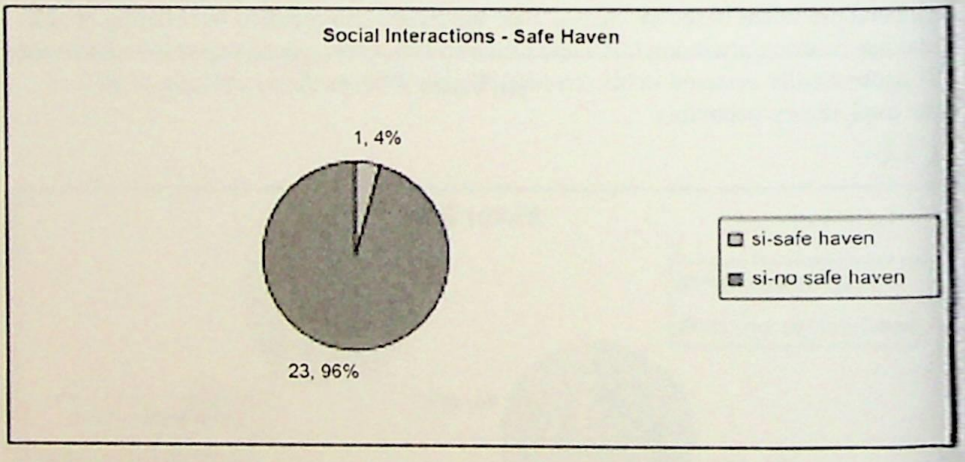


Figure 4. GRA's percentage of secure base use for both motor play (a.) and social interactions (b.) during the nine month period. He also exhibited safe haven characteristics in motor play (c.) and social interactions (d.)

Discussion

The purpose of this study was to determine whether belugas, in the care of humans, displayed aspects of attachment. We hypothesized that 1) beluga calves can form attachments to their mothers and use them as secure bases, which can be seen through their non-fearful exploratory play or social interactions, and 2) beluga calves form attachments to their mothers and use them as secure havens, which can also be seen through exploratory play or social interactions, involving fearful stimuli.

Attachments in many species result from frequent interactions during a period of time. Many situations give rise to the formation of attachments as beluga mothers care for their calves over extended periods and the calves are mobile directly after birth. As expected from previous studies (Connor et al., 2000; Gubbins et al., 1999; Krasnova et al., 2006; Mann & Smuts, 1999), the two calves in the current study spent the majority of their time swimming alongside their mothers across the first nine months. Unlike these preceding studies, our calves did not exhibit a steadily increase of distance away from their mothers. This finding may be due to health issues experienced by both calves at various times during the study. Despite the absence of a linear developmental trend, the calves were

observed initiating separations from their mothers and engaging in solo swims, swims with others, and exploratory behaviors. These findings corroborated those reported by Krasnova et al. (2006), investigating belugas in their natural habitat.

The frequency with which the calves swam with their mothers and returned to only them when separated for a period of time indicate that an attachment relationship was likely for both mother-calf pairs. Consequently, the appearance of exploratory play by the calves suggested that they were comfortable with their environment. Although approximately 80% of the calves' time was spent at their mothers' sides, they did venture away from them the remaining 20%. While engaged in these exploratory play behaviors, the calves exhibited motor play such as rubbing walls and solo swimming. Social interactions, which included swims with each other, chase games, and mouth games, were the next most frequent category of exploration for each calf followed by object play. Previous research has indicated that calves prefer to spend time with other calves when available (Connor et al., 2000; Krasnova et al., 2006; Mann & Smuts, 1999), thus it is not surprising that social interactions were more frequent than object play. Likewise, if a playmate or an inanimate enrichment device is not readily available, motor play is probably more likely.

During these exploratory play interactions, the calves exhibited a variety of attachment behaviors. For example, when the calves left their mothers, it was not uncommon to observe orients, decreases in proximity, returns, and contact seeking behaviors by the calves towards their mothers. These attachment behaviors in conjunction with their increased independence through voluntary separations and initiations of exploratory behaviors and social interactions, suggested that the calves sought protection and comfort from their mothers and not from any other beluga. Thus, it is likely that the two calves had formed an attachment to their mothers.

These attachments were confirmed by the observed display of secure base use by both calves. Though infrequent, both calves displayed secure base use to their mothers during motor play and social interactions. This trend corresponds to the finding that the frequency of social interactions engaged in by the calves was directly related to the frequency of motor play. Thus, it appears that as the calves began to venture further away from their mothers, they continued to monitor her activities in order to maintain their confidence and comfort. Furthermore, the likelihood of the attachment was strengthened as one of the calves appeared to use his mother as a safe haven as well. GRA returned to his mother during two stress-initiating situations, which took place during motor play and social interactions.

Although secure base and safe haven use did not occur often in the given study, the appearance that they did occur offers complementary evidence that the bond between beluga mothers and their calves may be classified as an attachment. Further research should continue to examine this mother-calf relationship with a larger sample of belugas so that the limitations of the current study can be fully addressed. Specifically, it is likely that the lack of clear developmental trends was due to the recurrent health issues of both calves as well as to the small sample size. Opportunities for secure base and safe haven behaviors may also have been hindered due to these same issues. Also, the contexts in which secure base and safe have occurred should be more clearly defined.

Can the bonds between beluga mothers and their calves be described as attachments? The fact that extended offspring care and constant monitoring by the mother occurs throughout the calves' first few years suggest that an attachment relationship exists. Second, their fission-fusion society allows calves to stay with and temporarily separate from their mothers while also allowing opportunities for independence and social activities. These forays away from the mother consequently create opportunities for secure base

and safe haven. While our calves actively engaged in exploratory play, they consistently returned to their mothers. We also observed the mothers to initiate reunions as well, with demonstrates the common bond between the mother and calf. As secure base use is a key behavior of forming an attachment, (Ainsworth et al., 1978) and safe haven use is an important display of the physical and psychological security provided by the attachment (Ainsworth et al., 1978; Bowlby, 1969), it seems probable that the relationship between beluga mothers and calves can be classified as an attachment.

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Xenon Dark Matter Experiment at Laboratori Nazionali del Gran Sasso

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Abstract

Located at the Laboratori Nazionali del Gran Sasso is one of several dark matter experiments nestled 1400 meters underneath the Gran Sasso mountain. During Summer 2008 I worked with the Xenon Dark Matter Experiment calculating the efficiency of a Germanium detector used to screen the background contribution of the photomultipliers (PMT) used in the Xenon100 experiment. The Germanium detector was created via GEANT4 Monte Carlo code where the detector can be manipulated to nearly replicate the workings of the actual detector. This efficiency is necessary to determine the accuracy of the radioactivity readings gathered by the real detector. The purpose of screening the PMTs was to determine the radioactive contribution of each PMT before placing them inside the detector for use. It was necessary to use PMTs with minimal contribution as they may inhibit the reading of the rare signals produced by WIMPs.

1. What is Dark Matter?

Dark matter is the non-luminous, non-baryonic matter that is said to compose about 23% of the universe. Meanwhile, 73% of the universe is composed of dark energy and only 4% is composed of baryonic matter. Dark Matter is considered to be cold and non-baryonic because it is postulated that dark matter greatly aided in the large structure formation of the universe by being slow moving, or cold, so that it clumps together to produce large gravitational effects that cause galaxies to cluster and also hold single galaxies intact by a galactic halo.

While there are many astronomical examples that point towards the existence of dark matter, some of the more popular examples come from Freidrich Wilhelm Bessell, Fritz Zwicky, Vera Rubin and the CMB anisotropies.

The first prediction for dark matter came from Freidrich Wilhem Bessell in 1844 as he studied the sinusoidal displacement of the star Sirius and noted that there must be an invisible companion to cause such a trajectory. In 1864, however, this invisible companion was discovered as Sirius B, the white dwarf (Sirius). Later in 1933, US/Swiss astronomer Fritz Zwicky used the Virial Thereom to calculate the mass of a region of galaxies on the periphery of the Coma Cluster. He found that the amount of mass needed was much greater than what could be calculated from the brightness of the galaxies in the cluster. However, very few people in the scientific community believed him until other theories also began to point to the existence of something like dark matter. In the 1960's Vera Rubin also concluded that the velocity on the outer arms of the galaxy to do not follow the Newtonian dynamics of centripetal acceleration. As the radius increases the velocity should slow down, but in fact on the outer arms of spiral galaxies the velocity was equal to the inside and sometimes even greater! Velocity dispersion in galaxies at large radii is probably the most promising evidence for dark matter (Ni, 15).

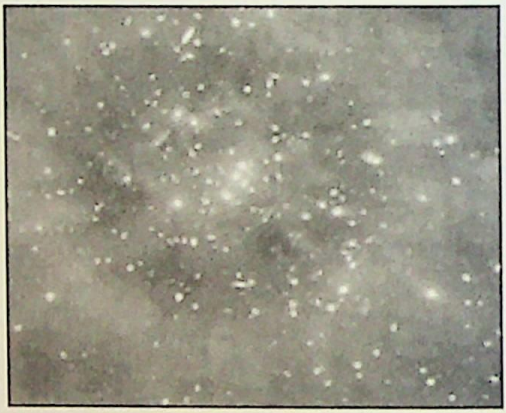

Figure 1.1: Image Galaxy cluster CL 0024+17 from Hubble Space Telescope depicts a ring of dark matter.

The polarization of the cosmic microwave background is another example pointing to the existence of dark matter. The CMB is the radiation resulting from the big bang and exists throughout the universe. Generally the CMB spectrum (Figure 1.2) has the likeness of a black body spectrum, however, with small anisotropies, or irregularities, that point to fluctuations in matter density. These anisotropies can be used to study the initial conditions of cosmic structure formulation. Various details in this analysis results in the favored existence of dark matter.

Figure 1.2: Temperature fluctuations in the cosmic microwave background.

While there is much theoretical evidence pointing to the existence of dark matter, experimental evidence has yet to be discovered. There are many experiments across the globe that are trying to detect dark matter directly and even indirectly. WIMPs (Weakly interacting Massive Particles) are one of the candidates for dark matter, but the nature of these particles is still unknown. The most favored candidates under this category are neutralino from supersymmetry (SUSY), the Kaluza Klein particle and the axions (Ni, 00). WIMPs from the dark halo of our galaxy should elastically interact with ordinary matter nuclei via the weak force and gravity and induce nuclear recoils. They also have a large mass compared to standard particles. By detecting experimental evidence for these WIMPs, scientists expect to find a new realm of physics in need of further discovery.

II. The Xenon Dark Matter Experiment

Starting in 2002, Xenon has developed through various stages of R&D up to Xenon100 today. The Xenon collaboration hopes to continue it's direct detection of dark matter by increasing to the Xenon 1 Ton which will contain 10 identical 100kg Liquid Xenon time projection chambers (TPCs).

Xenon100 is a dual phase time projection chamber that enables the direct detection of dark matter through scintillation and ionization of LXe by WIMPS.

With over 200 PMT's arrayed over the top and bottom of the detector to catch the scintillation light produced in the Xenon, Xenon100 holds 100kg of LXe in a tank that also has a gaseous xenon layer above it.

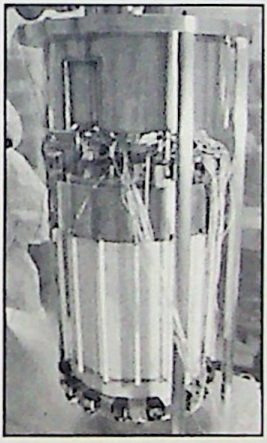

Figure 2.1: Xenon TPC

As well as the rare WIMP, many other high particles can bombard the detector, but since Xenon100 is only interested in collecting data from low energy nuclear recoils the detector must be shielded from as many of these high energy particles as possible. Firstly, this explains the location of the experiment 1400 meters underneath Gran Sasso. The rock provides a lengthy shield that can slow down many high energy particles and reduce some from coming into the detector. Lead shields are also placed around the detector to reduce the number of high energy muons going into the detector. This greatly reduces the amount of electron recoils that the detector will see. On the other hand, the problem with detecting nuclear recoils for WIMPS is that neutrons also produce nuclear recoils. Discerning between the two particles isn't difficult when the neutrons have a high energy; in this case the neutrons will scatter multiple times and the recoils will stand out from those expected from WIMPS. To reduce the number of low energy neutrons, a plastic shield

made of polyethylene was set in place to slow down neutrons and ideally prevent them from entering the detector. Only a small fraction of nuclear recoils produced by neutrons is known to occur. The rest would ideally be caused by WIMPS scattering off the nuclei of the LXe.

Illustration of nuclear and electron recoils

A cathode and anode are positioned at either end of the detector to produce an electri field that drift electrons from the ionized liquid into the gas. By electroluminescence, the drifting electrons are able to recombine with Xe gas and produce photons through this interaction. The collaboration collects data in forms of signals from the ionization of the LXe (called the S1 signal) and the proportional scintillation produced in the gas Xenon (called the S2 signal). The key to differentiate between nuclear recoils and electron recoils is in the comparison of the S2 signal to the S1 signal. Ideally, the proportional scintillation produced by nuclear recoil will be much less than the primary scintillation. The reverse is true for an electron recoil event where the S2 signal will be much greater than the primary S1 signal. Comparing these ratios will show the electron recoil ratio to be much larger than that of the neutron recoil (Ni, 50).

III. REU

The detection of WIMPS requires equipment that is sensitive to low thresholds of energy. Since radiation is everywhere it is necessary to take good measurements of background radiation in order to subtract uninteresting events that the detector will pick up. Xenon must be concerned with all radiation types - gamma, beta and alpha – and als be on the lookout for nuclear recoils caused by neutrons as well as WIMPS. Background comes from outside the detector as well as from the inside of the detector. From the outside, most background radiation is caused by the decay chain of 238-U and 232-Th and decay of 40-K. These chains can produce gamma rays through their decays. They can also emit alpha and beta particles that can interact with the surrounding rock to produce high energy neutrons. Additional background radiation is caused by cosmic rays, such as high energy muons, which can interact with the LXe to produce neutrons inside the detector (Ni, 52).

Xenon has already gone to great lengths to reduce the detectors intake of outside background radiation with lead shielding to block penetrating gamma ray, beta and alpha particles and polyethylene shielding to block most low energy neutrons. With much of th outside radiation blocked, the collaboration is able to focus their attention on the background caused by the various equipment pieces inside the detector. This involves testing as many of these objects as possible with their available germanium detector named 'Gator' and making sure they only place the lowest activity instruments inside the detector.

I spent the beginning of my summer reading papers about Dark Matter and the XENON experiment. Later in the summer I got to work with PMT's and the blackbox, but the majority of my summer was spent learning ROOT by recreating data gathered by Alfredo Ferella using the 'Gator' germanium detector. Germanium detectors are semiconductor detectors and, in this case, Gator is a coaxial high purity germanium detector. Semiconductor detectors function similar to the Xenon TPC in the sense that high energy particles come into the detector and excite the element inside. In the event that a gamma ray comes into the germanium detector, the photon can deposit energy into an electron, thereby exciting it so the electron creates a hole by moving from the valence band to the conduction band. An electric field is applied across the crystal volume and moves the free electrons to one end of the electric field and the holes produced move to the other end of the electric field. When the electrons and holes are gathered at the contacts they create a signal that is sent to a preamplifier and other necessary modular electronics. This detector produces good energy resolution and timing resolution, but it must be cooled to liquid nitrogen temperatures so that the valence electrons can only be excited by high energy particle interactions. Warmer temperatures allow thermal excitations to occur inside the detector causing poor resolution for high energy particle interactions.

The following data is from a background run conducted in March 2008 by Alfredo Ferrella. The first two graphs are the steps taken to normalize the raw data collected from Gator. The raw data consisted of channel numbers and counts for each channel corresponding to energy depositions for the Gator background.

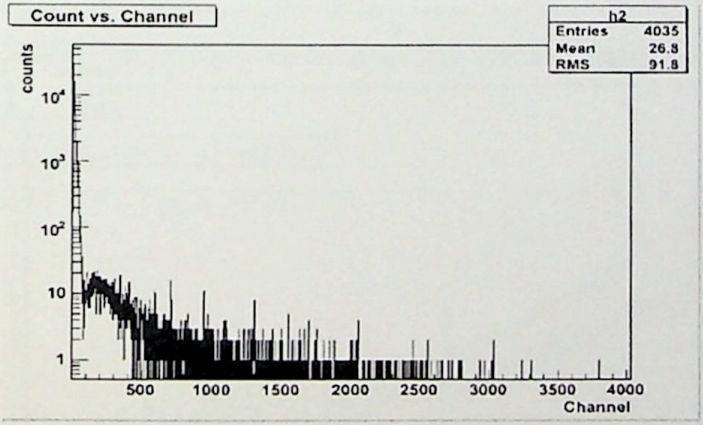

Figure 3.1: Raw data, background spectrum.

I calibrated the peaks using a linear fit. The slope of fit, as well as the live time of the run and the mass of the detector allowed me to calculate the differential rate unit (DRU), which normalizes the spectrum.

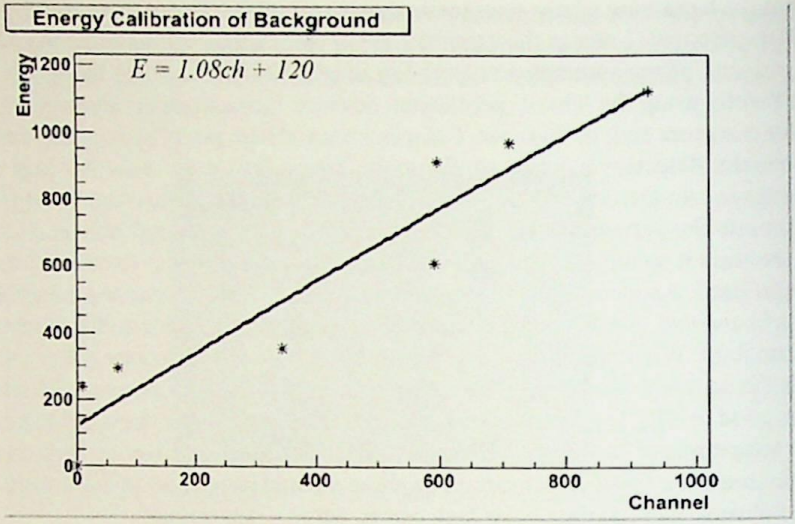

Figure 3.2: Energy calibration using linear fit.

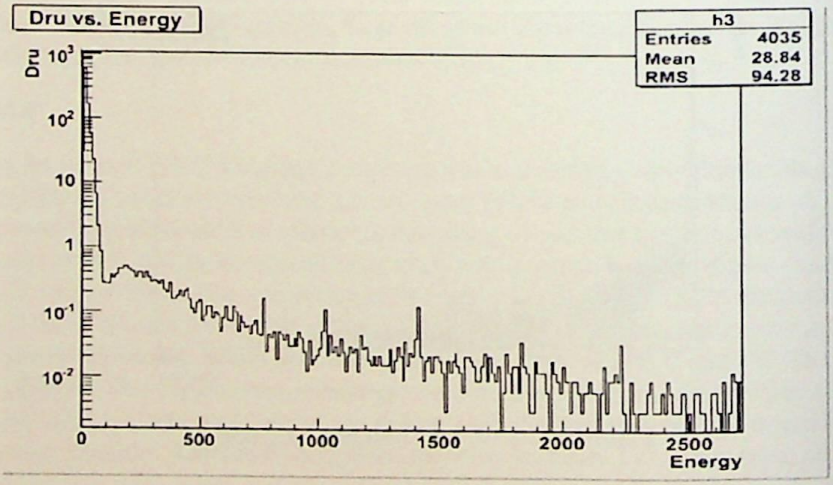

Figure 3.3: Normalized background spectrum.

Similar to the background data, the following data consisted of channel numbers and counts for each channel corresponding to energy depositions for several PMT bases used for the Xenon100. This data was taken in November 2007 by Alredo Ferrella. I found energy deposits corresponding to the decay chain or Uranium-238 and Thorium-232 in this sample, namely: 1120 keV, 1765 keV, 352 keV, 295 keV, 609 keV from the 238U chain and 239 keV, 911 keV, and 969 keV from the 232Th chain because they have the highest probability of emitting these types of gamma rays.

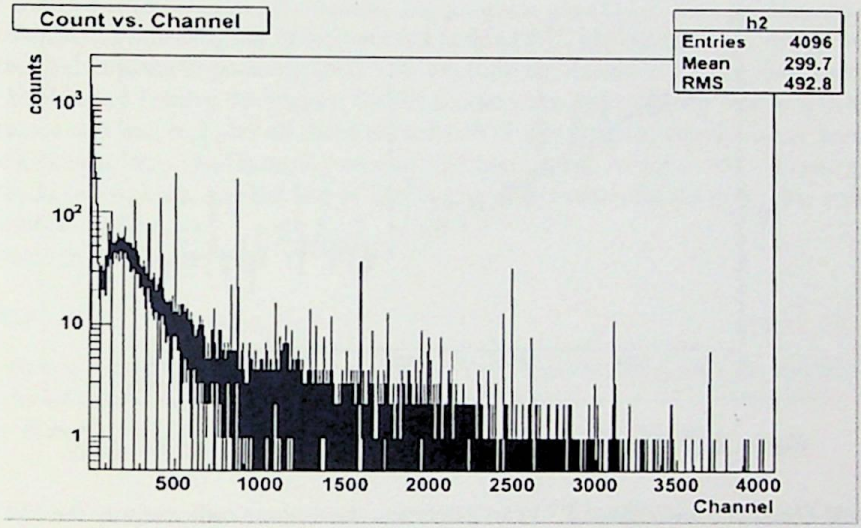

Figure 3.4: Histogram plotting the counts and channels from the raw data.

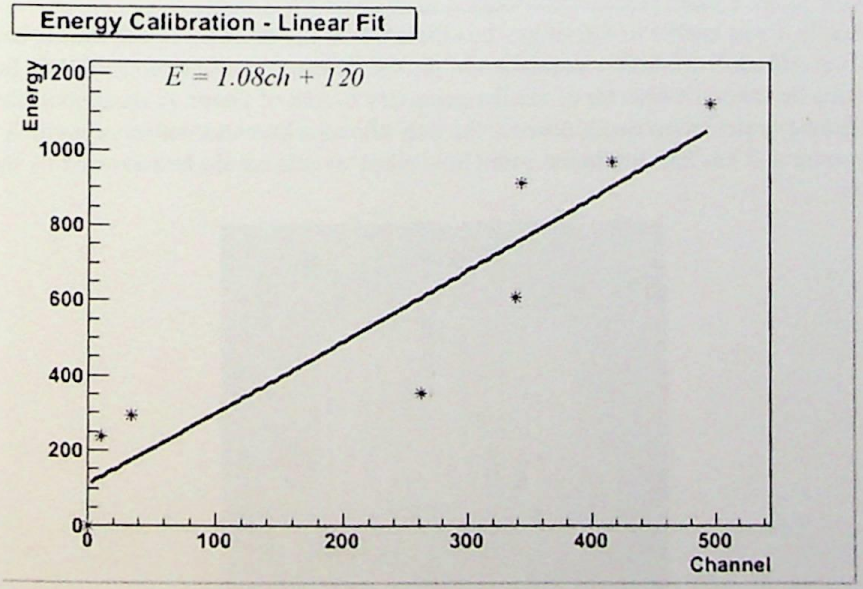

Figure 3.5: Energy calibration for PMT Bases.

Calibrating the energies produced a linear fit which can be used to find all the corresponding energies from the spectrum. This equation also helps when graphing Dru (counts/(kg*energy/bin*days)) against the energy; this produces a normalized spectrum that can be compared with other spectrums plotted in this fashion.

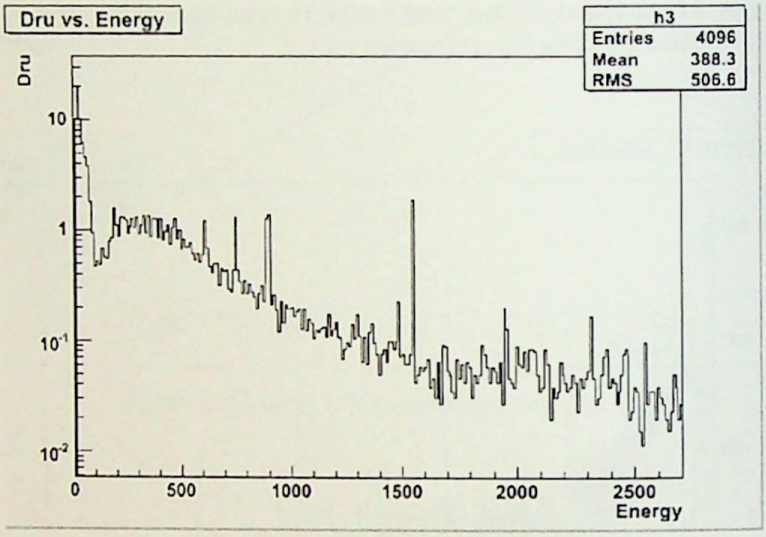

Figure 3.6: Normalized plot of PMT Bases count rate versus energy.

Using Figure 3.6 and Figure 3.3 I can determine the amount radioactivity the PMT bases produced by first determining the efficiency of the detector and then subtracting th background data from specific peaks produced by the PMT bases spectra. This would give me the number of counts/sec for each peak. Then, multiplying this by the efficiency allows me to see a more precise contribution from these PMT bases.

Actually, I was unable to determine the efficiency of the detector so the results calculated from Alfredo's GEANT4 simulation of the Ge detector would have sufficed. In th simulation he created a detector of similar geometry to that of Gator. A simulation make this efficiency calculation easier because the user allows a known number of gamma ray events occur and lets the simulation count how many events would be recorded by the detector.

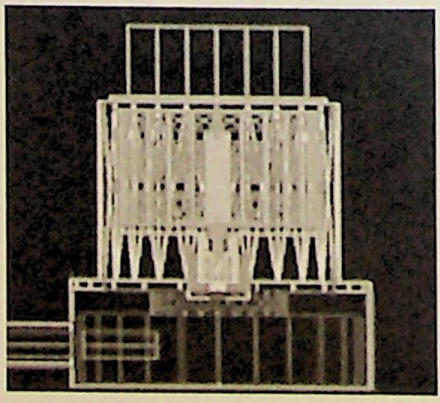

Figure 3.7: GEANT4 simulation of Gator.

V. Conclusions

As far as determining the background contribution of these PMT bases. I was unable to determine them due to time constraints, among other things. However, whatever results would have found would serve as a comparison to the results concluded by Alfredo Ferella. The measurement of the activities of the equipment inside the detector is extremely important as it contributes to the scintillations gathered by Xe100 and these signals must be sorted out in order to lower the energy threshold for detecting WIMPS.

Of course, the summer can not end properly without showing my appreciation to those who were involved in my summer. My gratitude goes to Dr. John Parsons and Dr. Elena Aprile for allowing me to be involved in this REU. My appreciation also goes to the National Science Foundation (NSF) for allotting the funds for this program to function. However, I believe the biggest thanks should go to those directly involved in my experience and that includes all those here at LNGS this summer, especially my house mates Kaixuan, Bin, Tae-Hyun, Kyungeun "Elizabeth", and Andrew. Also, thanks goes to Alfredo for his help, and the rest of the Xenon collaboration for the enjoyable and memorable experience.

Grazie mille!

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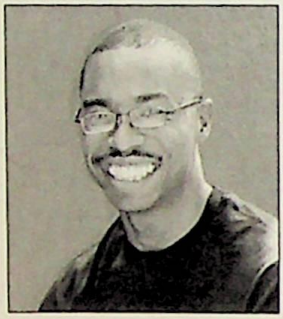
Thermal Optics Effects: Finding the Reduced Scattering Coefficient



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Abstract

The experiment's main goals were to find the reduced scattering coefficient. Dr. Lindbe and Dr. Larsson from Linkoping University in Sweden also performed this experiment, a this work entailed re-creating this experiment by verifying and amending its results. I Daniel Emmons from the Air Force Research Laboratory worked jointly in observing t optical changes made to a polystyrene and water solution by laser beam, simulating e and skin tissue. The hypothesis examined how the laser would propagate within the tiss and any changes in optical structure were recorded.
To record these changes, LabView software processed digital images of the laser propag tion to make a dynamic 3D graph of the light intensity over pixel count. Also, the progra controlled the exposure time of each image, so it would not interfere with the beam prop gation. The research required Red #4 dye to monitor the Class 3B Helium-Neon bea as the light scattered throughout the material. By finding the scattering coefficient, t distance between the point of incidence and the diffuse (scattered) center, the propagati of light in this simulated tissue substance becomes measurable.

Introduction

One measurement of light propagation within a substance is finding the reduced scattering coefficient. By calculating this reduced scattering coefficient, the changes in the thermal optic properties due to propagation of light within the substance becomes apparent. The ultimate goal seeks to examine which intensities cause light to damage eye and skin cells, and find optical methods of detecting those changes.

Background

Dr. Lindberg and Dr. Larsson deduced that it would be easier to measure scattered light distribution using a 3D dynamic range graph, as opposed to a 1D single line measurement. The 3D graph gives a clearer picture of the threshold images, and easier deduction of the scattering and absorption coefficients. However, this experiment focused just on finding changes in scatter patterns, which affect the light propagation. The different methodologies of the previous experiment became the base of this project's procedure. According to their works, the scattering and absorption coefficient affects the light propagation in tissues, because both factor into the tissue structure and chromophore content. The slight deviations in both variables changed the optical properties and the status/conditions of the tissue. To verify and analyze these results, the joint research Lt. Simmons followed the example of using spatially resolved diffuse reflectance (SRDR), to begin to calculate the scattering coefficient. Also, Dr. Lindberg and Dr. Larsson's use of non-contact oblique angle illumination, and a multiple-image based algorithm for a large dynamic range in scatter measure, allowed the Laser Scattering experiment to begin.

The experiment's goals included following the baseline concept for finding the reduced scattering coefficient. Figure 1.1 below illustrates this idea:

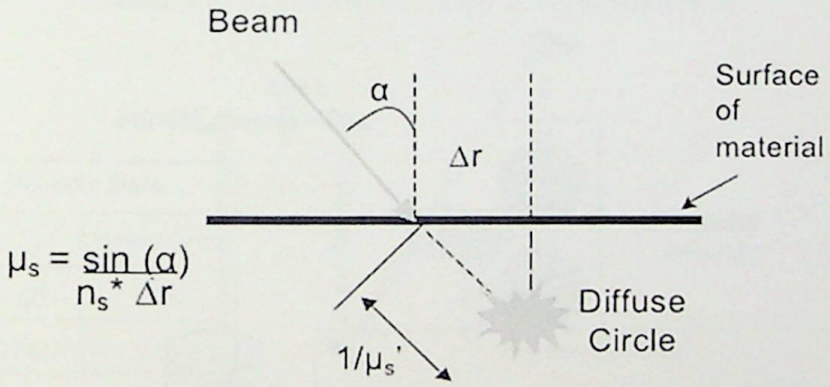

Figure 1.1: Oblique incidence beam to diffuse circle.

When the laser beam penetrates a material, the incident beam is not always at the same angle of penetration, and the beam scatters throughout, forming a circular pattern within the material. The difference between the penetration point center and the center of the diffuse circle is called the reduced scattering coefficient, μs. The equation shown in figure 1.1 describes the sine of the angle between the imaginary horizontal line, and the beam divided by the index of refraction, which is then multiplied by the horizontal shift between the diffuse center and point of incidence (Dr. Larsson and Dr. Lindberg). This equation derives from a geometric perspective, and gives an outline concept to begin our experiment.

Theory

An outline of the research's approach and methods was then devised. The staff noted that the multiple-image based algorithm would likely take the most time, because many images had to be processed to form our 3D dynamic range graphs. The research used LabView 8.2, a software program that implements virtual controls and circuits that simulate real-world applications, to control the outside hardware through National Instruments adaptors.

Also, observations indicated that because of the complexity of the image processing involved, camera intensity calibrations and dark count pixels would need to be removed from each image to display a proper region of interest (ROI) for the graph. All of these things were early warning signs of difficulty of the experiment, but they seemed that much smaller because of resources at hand.

Materials and Methods

The staff in the Laser Optics Department proved to be invaluable. Mr. Gary Noojin provided knowledge on different powers and classes of lasers and the corresponding safety rules, and Dr. Robert Thomas provided the technical guidance that made sure all portions of the experiment progressed smoothly. Equipment used was several convex mirrors, a green class 3B Helium-Neon (HeNe) laser, a wattmeter, integrating spheres, and a polarized electronic shutter. The first step in the procedure required measuring the light intensity of the beam to at various points to determine an average power range. HeNe lasers are traditionally low-power lasers that called for a microwatt power scale. The max output of the laser is only 5mW, yet measured strong enough to damage human eyes (Milonni). Figure 1.2 illustrates the laser intensity set-up:

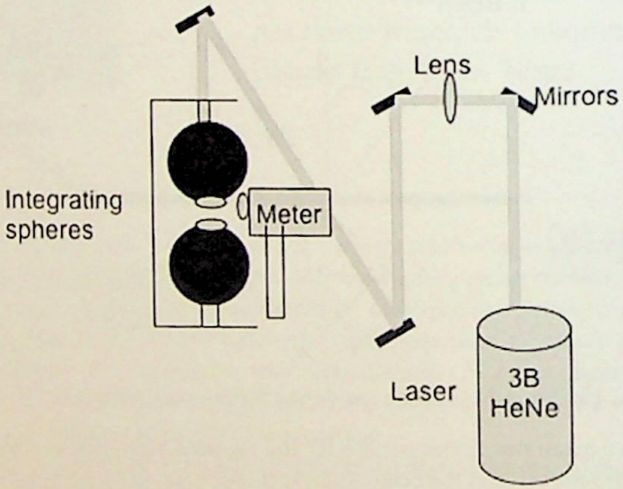

Figure 1.2: Laser intensity test.

The intensity test began with the reflected beam perfectly parallel to the laser, which took great precision. If this measurement was incorrect, the integrating spheres did not produce a correct power measurement. Mr. Noojin gave useful tips on how to align the mirrors on their posts such that the test needed little equipment to accomplish this task. The integrating spheres themselves contain a diffuse reflective interior surface that bounces the beam about the sphere and reflects into the wattmeter. Graphing the power measurements before proceeding into image processing afforded correct calculations for the 3D graph. Also, each exposure time determined by Dr. Lindberg and Dr. Larsson provided a smaller average power range; therefore this experiment included some additional exposure times in between to make sure that there were enough points for a larger dynamic range. Pixel count also supplemented of the power readings and subtracted unnecessary noise from each image. Some examples of these intensity and average pixel count graphs are listed below in tables 1.1-1.3:

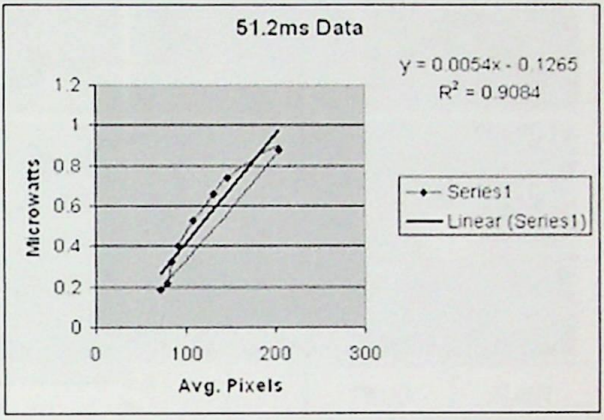

Table 1.1 - 51.2ms Intensity graph for camera calibration.

102.4ms Data	
Avg. Pix.	Power (uw)
206.65	0.53
75.74	0.07
85.61	0.108
98.36	0.146
116.13	0.187
129.16	0.216
147.66	0.323
169.59	0.4
80.97	0.089

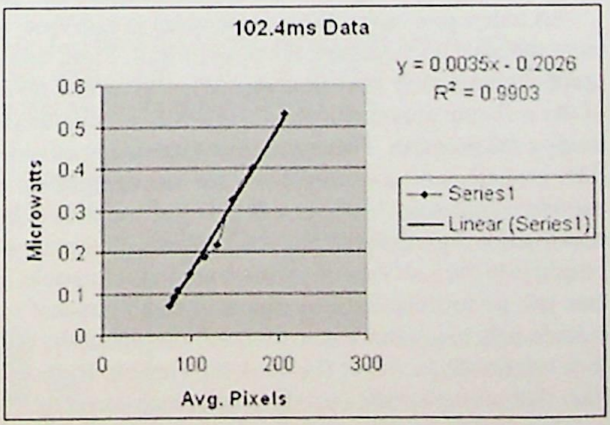

Table 1.2 - 102.4ms Intensity graph for camera calibration.

204.8ms Data	
Avg. Pix.	Power (uw)
92.79	0.034
101.53	0.046
119.42	0.06
127.69	0.07
133.17	0.089
140.84	0.108
165.49	0.146
196.7	0.187
222.23	0.216

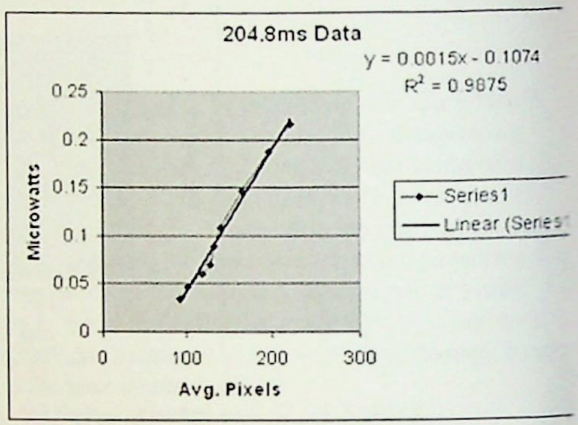

Table 1.3 - 204.8ms Intensity graph for camera calibration.

Each graph has a 'best fit' linearity on it because this provided the equation necessar to determine at which intensity would be produced by each exposure time. There were eleven different exposure times at which the images were gathered, and an average inte sity range derived from the points produced a table in which the LabView file processed them into a 3D dynamic graph. This task however, presented its own array of problems because the camera response was not linear with the power or exposure time. This mea that the processed images would appear distorted and skewed.

An image processing filter constructed in LabView would remove the fluctuations from the laser and maintain the desired ROI. From this image processing device, the 3D graph would appear smooth across all surfaces and revealed itself to be the main portio of the software experimentation. However, numerous problems plagued the project whi writing the program. There was little knowledge outside of the staff on how to design th filter properly, and each new filter that met completion needed additional parameters to operate completely. Also, for a majority of the time debugging issues slowed the softwa construction significantly. However, during all these trials, the opportunities for much insight into the LabView program were immeasurable. The research process meant mor than just performing the experiment at hand; it meant scanning textbooks and seeking outside help to answer unknown questions about the program's different functions and their relationships. All of the work did come to fruition when joint efforts resulted in a filter that processed the outside interference correctly.

The outside interference was also caused by excessive dark count pixels and camera calibrations. This proved additional data was needed. In a lightless room, 40 pictures were taken over the 200ms range of exposure times, and subtracted the dark pixels from the images taken in the LabView program. Now images were ready to be taken with just a milk and water solution to simulate the polystyrene solution. This process the staff described as static because the solution was not heated, with results shown in Figure 1.3

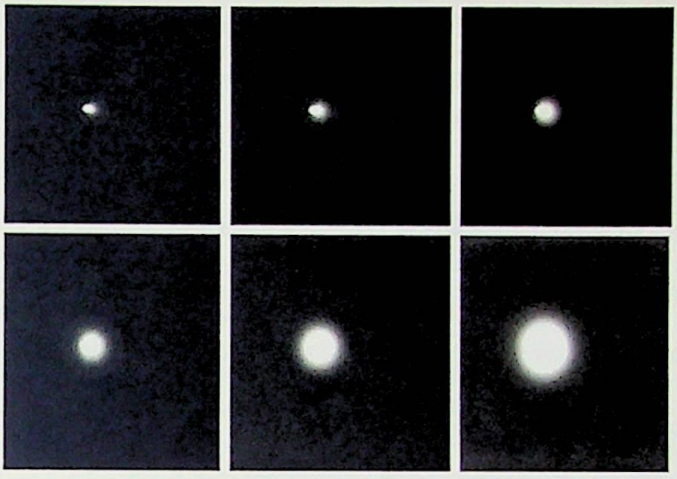

Figure 1.3: Exposure times: 3.2ms to 204.8ms

Each image at the six different camera integration times of 3.2ms, 6.4ms, 25.6ms, 51.2ms, 102.4ms, 204.8ms had become progressively larger and more circular as the exposure time increased. In the upper left-most image, an asymmetry is clearly present, but not seen in the saturated central parts of the lower images. Also, as the light scattered throughout our material, the ROI was easier to discern. From these images a good estimate of the hot-spot, or center, of the diffuse circle is seen. From this estimation, Δr is calculated and substituted into the equation found in Figure 1.1. Once the LabView program functioned correctly, the final step was to complete our experiment using the polystyrene spheres and water solution.

Data and Results

The final experimental laser set-up had used the 500mL solution of polystyrene spheres of 5μm in diameter and water, with exactly 0.201g of red dye. The dye reduced reflection off of the surface of the water as illustrated in Figure 1.5:

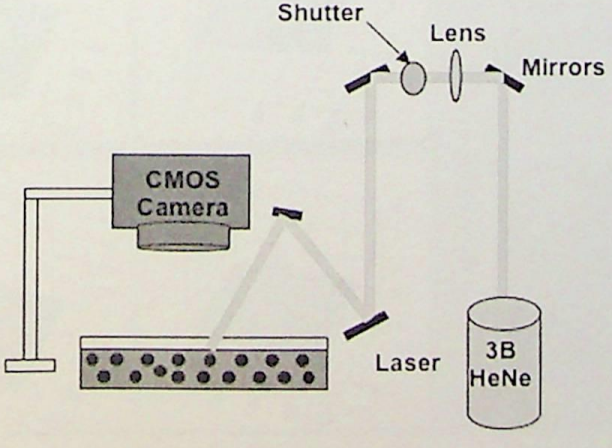

Figure 1.5: Polystyrene solution set-up.

Gathering the data from this new set-up gave the shift in the scattering formulated in the project's hypothesis. In the previous experiment, Dr. Larsson and Dr. Lindberg deduced that the scattering coefficient would be easier to measure using methods shown in the 3D dynamic range plot listed in Figure 1.6:

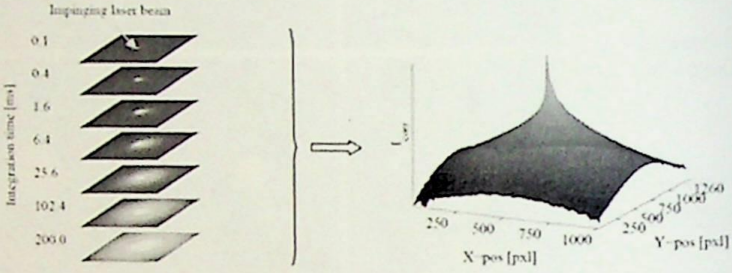

Figure 1.6: 3D dynamic range plot.

Following this example, the hypothesis stated there would be some scattering in this latter part of the experiment because the solution needed ten seconds to heat up to show some of the bio-effects of laser imaging. Even though it was a low-power laser, the solution was able to heat up by about 0.25 °F during that time. This increase in temperature was enough for us to detect a change in the scattering pattern and affect the optical properties of the solution (Young). Observing the thermal scattering in at the different camera integration times, there was a 3%-5% increase in the scattering patterns from the static images. Detectable changes in light propagation in the solution afforded a way to calculate the exact diffuse center. The 3D high dynamic range is illustrated in Figure 1.

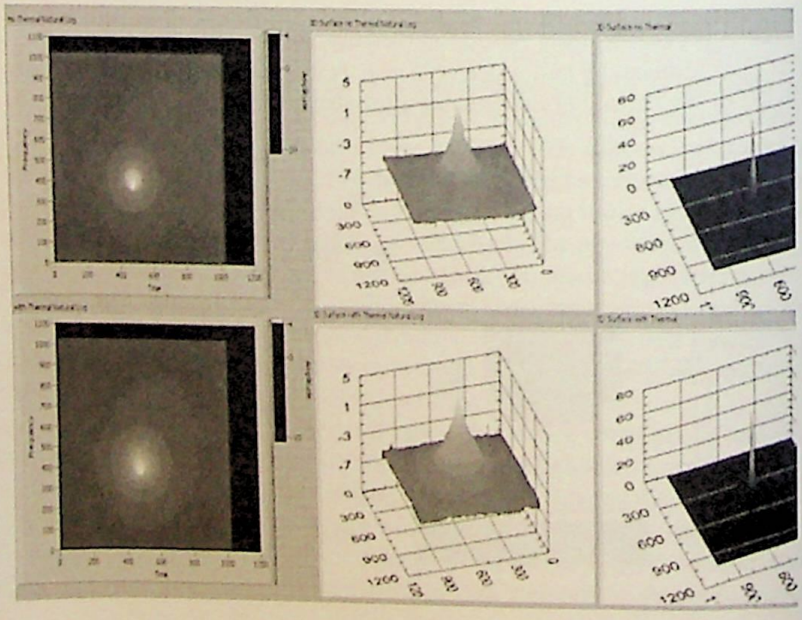

Figure 1.7: 3D dynamic range plot from polystyrene solution

These results verified the prediction that there was going to be a change in the dynamic images, but unfortunately no definitive scattering coefficient within the eight week period. However, all research projects takes time, and this work will continue at the Air Force Research Lab.

Future Work/Conclusion

The major portion of the image processing could have been made easier by taking into account the dark count pixels from the camera integration times before making the 3D high dynamic range graph. In Dr. Lindberg and Dr. Larrson's experiment, they mentioned their threshold images were processed in different way. They used image thresholding over a range of seven steps and used pixels versus position axis, and the experiment used intensity over average pixel counts. Although they used fewer integration times, the 3D graph was simpler to observe the changes between static and dynamic ranges.

With the scattering coefficient results still pending, great advances are being made to calculate the exact scattering coefficient. Using the data and the equation from Figure 1.1, the staff expects to receive a value less than 1.5 degrees, meaning the light propagates within the material but only by a small degree. Other predictions explore some ideas like optical changes within the material will not damage the tissues, but at longer beam exposures or a stronger laser will definitely have more adverse effects. Much insight and experience has been gained in this field of optics which will benefit this experiment and others like it well into the future.

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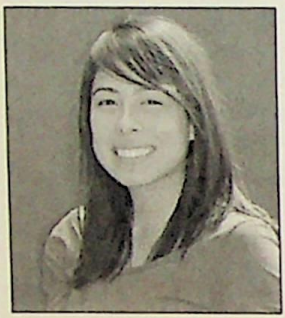
Gender Stereotyping in Children: A Pilot Study



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Abstract

Gender-role stereotyping is the process whereby gender appropriate behavior and beli about what males and females are expected to do are acquired. Methodologies used prior research to measure gender-role stereotyping have several limitations. The purp of this study is to address these limitations by developing new measures of gender-r stereotyping for middle-childhood children that are reliable, valid, and easily admin tered. The Gender-Role Stereotyping Questionnaires (GRSQ) measure gender- stereotyp personality attributes and activities. Children are asked to rate 12 personal attributes how descriptive each item is of the typical boy or girl. In a pilot study, 12 children betw the ages of six to nine completed the GRSQ and the short form of The Children's Sex R Inventory which asks children about perception of self. Children are also asked to pl pictures of different activities into one of three labeled boxes—boy, girl, or both boy a girl. Preliminary results indicate that the GRSQs appear promising as measures of gend role stereotyping in middle-childhood children. Children found both measures to be u derstandable and easy to complete. In addition, the GRSQ assessment of how the typi boy or girl might answer a gender stereotype item may be tapping another dimension gender-role stereotyping that other measures have neglected.

Gender-role stereotypes are widely held beliefs about characteristics typical of males and females and extend to activities and personality attributes. Cultural traditions and norms play a large part in shaping gender-role stereotypes. In Western cultures, femini stereotypical activities include household tasks and child care activities and masculine stereotypical activities include maintaining a full-time career, yard maintenance, and vehicle maintenance (Mannino & Deutsch, 2007). With reference to personality attributes, females are stereotyped as warm, nurturing, and sensitive and men are stereotype

ass independent, rational, and competitive (Berk, 2000). Children, the typical boys are regarded as aggressive, active, and good at spatial and mathematical skills, whereas the typical girls are passive, gentle, and good at verbal skills (Berk, 2000). The process by which children become aware of and develop gender-role stereotypes is subject to considerable research, with much of it focusing on the influence of parents and the media as socializing agents.

Toddlers acquire the ability to label their gender and that of others when they learn the words "boy, "girl," "man," and "woman," (Berk, 2000). This ability to sort out perceived information into appropriate categories occurs around the age of two years. In a study (Poulin-Dubois, Serbin, Eichstedt, & Sen, 2002) where toddlers were given the choice to model an activity using either a doll representation of "mommy" or "daddy," boys showed knowledge about their gender by the age of 31 months and girls as early as 24 months. As toddlers develop certain generalized attitudes about themselves, they also develop ideals to measure themselves with whom they need to be like instead of who they want to be like. For example, girls described their father as more competent and powerful than mother, but when asked who they wanted to be like when grown up, girls chose mother (Kagan & Lemkin, 1960).

By preschool (age four), children's preference for stereotypical roles and activities is highly gender-typed. Banerjee and Lintern (2000) interviewed children from the ages of four to nine years alone and then again with a group of peers. Children were asked to describe their activity and toy preferences. Four-year old children's responses both alone and in groups were more gender-typed than any other age group. In another study (Leinbach, Hort, & Fagot,1997), children were asked to sort flash cards with drawings of masculine or feminine items, such as a "hammer," "rifle," "broom," and "iron," and metaphorical qualities like "angularity" and "softness" associated with gender. All children chose more flash cards as pertaining to their gender than for the opposite gender, indicating a greater knowledge of items appropriate for their gender.

Middle-childhood children stereotype academic areas and academic proficiencies by gender. Colley and Comber (1994) found that girls' preference for subjects such as humanities and music is associated with higher femininity and lower masculinity, while boys' preference for physical exercise was associated with higher masculinity and lower femininity. In another study, Tiedemann (2000) found that boys believed themselves to have a superior ability to perform well in mathematics. When third and fourth graders were asked to assess their mathematical ability and predict the grade they would receive on the next math test, boys reported greater abilities and higher grades in mathematics even though boys and girls had the same grades in the class.

Studies to date show that older children are aware of gender stereotypes, yet they adopt a less restrictive and more flexible view of gender roles (Banerjee & Lintern, 2000; Katz & Walsh, 1991; Leinbach, Hort, & Fagot, 1997). However, a greater flexibility of gender attitudes is not reciprocated by increased involvement of cross-gender behavior. Katz and Walsh (1991) asked seven and ten-year olds to complete an assessment evaluating their gender-role flexibility and to engage in several gender atypical activities, such as reading opposite-gender comic books, promote opposite-gender toys, and acting out opposite-gender professions in a charades game. Although older children declared more flexible gender-role attitudes on the questionnaire, they were more reluctant to participate in atypical gender behavior. Moreover, this reluctance was more evident in boys than girls. Pollack (2006) argues that girls have more freedom to explore masculine and feminine roles; yet, boys feel more embarrassed and may actively be avoiding any activity that may be perceived as feminine. Clearly, children's' social context reinforces the effect of gender attitudes and influences the degree of adaptation of gender-role stereotypes.

Gender-role stereotyping in children has been assessed with several different methodologies. A review of the published literature since 1959 reveals that gender-role stereotyping in middle-childhood children has been assessed by ten different questionnaires. One frequently used measure is the Children's Sex Role Inventory (CSRI; Boldizar, 1991). The CSRI is based on Bem's (1974) Measurement of Psychological Androgyny (BSRI) inventory that classifies an adult as masculine-gender typed, feminine gender-typed, or androgynous based on self-descriptions of personal attributes. Similar to the BSRI, the CSRI asks children to respond to 60 statements about self and provides scores for three measures: gender-role stereotyped masculine, gender-role stereotyped feminine, and neutral. The CSRI appears to be both reliable and valid with high internal consistency and test-retest reliability as reported by Boldizar (1991). A short version of the CSRI consisting of ten gender-role stereotyped masculine, ten gender-role stereotyped feminine, and ten neutral items was also validated, yielding good psychometric properties (Boldizar, 1991).

Although both the long and short forms of the CSRI appear to be psychometrically sound, a potential problem with these instruments concerns the nature of the questions asked. The CSRI asks children to rate how true gender-role statements are about themselves but does not ask about children's perception of gender-roles for the typical boy or girl (i.e., stereotypes). Self-discrepancy theory (Strauman & Higgins, 1987) suggests that a gap exists between middle-school age children's perception of what is true about themselves and their perception of what is true about others. In essence, this theory suggests that differences exist between who we think we ought to be and who we actually are. In one pilot study investigating this theory, almost all (98%) of the adult participants demonstrated a self-discrepancy when listing characteristics of who they were and who they thought they ought to be (Francis, Boldero, & Sambell, 2006). By contrast, Ruble (1987) found that young children (under the age of seven or eight) do not exhibit a discrepancy between self and others. This lack of discrepancy may be related to the developmental trend that young children have difficulty taking the perspectives of others and perceiving others' intentions and beliefs. While young children are able to demonstrate an implicit knowledge of gender-role stereotyped activities as indicated by preferences for those gender-appropriate activities, they often cannot give explanations for these stereotypes (Perry, White, & Perry, 1984). Older children (around age seven), however, begin to explicitly compare themselves to others (Ruble, 1987) and comparisons between self and others become more salient.

Gender-role stereotyping in children has also been assessed through children's activity and toy preferences. In an early study, Walker (1964) asked children to check "like" or "dislike" for games they have actually played in a list consisting of 134-items. Results showed that girls chose more feminine stereotyped activities (i.e. drawing) and boys chose more masculine stereotyped activities (i.e. playing football). In a recent study (Blakemore & Hill, 2008), adult participants were asked about their attitudes on children's gender –related toys and activities. Factor analysis revealed a total of 28 items considered to be stereotyped for either girls or boys. There are problems, however, with these measures. The 1964 study is dated and does not contain activities in which children are currently involved and the more recent study asks adults to rate the activities rather than children themselves and there may be a disconnect between what adults perceive as interesting to children and what children themselves perceive to be of interest.

There is a need to develop a measure of gender perception in children that assesses not only perception of self but also perception of gender- role in others. It is also necessary to update the children's activities and toy preferences. The purpose of this study is to develop measures of gender-role perception, one that assesses gender-role perception of

others and one that assesses contemporary activities and games of interest to children.

Method

Materials

Two questionnaires, the Gender- Role Stereotyping Questionnaire: Personality (GRSQ-P) and the Gender- Role Stereotyping Questionnaire: Activities (GRSQ-A), were developed. The GRSQ-P consists of 12 items adapted from the CSRI (Boldizar, 1991). Four statements from the gender-typed masculine, gender-typed feminine and gender-neutral category were chosen from the short version of the CSRI and matched to words or brief phrases that were selected by psychology professors and psychology students (see Table 1). In the GRSQ-P, children indicate how true each of the items is about themselves and how true each of the items is for the typical girl (if a female respondent) or typical boy (if a boy respondent) on a 4-point scale. The average for the four masculine items and for the four feminine items was computed, yielding two scores, a masculinity score and a femininity score.

Table 1

Items from the Gender-Role Stereotyping Questionnaire- Personality (GRSQ-P) and equivalent items from The Children's Sex-Role Inventory

CSRI	GRSQ-P
Masculine items	
When I play games, I really like to win.	Important to win
I am sure of my abilities.	Confident
I stand up for what I believe in.	Strong
I am good at taking charge of things.	Leader
Feminine items	
When someone's feelings have been hurt, I try to make them feel better.	Cares about others feelings
I am a cheerful person.	Cheerful
I am gentle person.	Gentle
When I like someone, I do nice things to show them how I feel.	Affectionate

The GRSQ-A consisted of four gender-typed masculine activities, four gender-typed feminine activities, and four gender-neutral activities. These activities, presented in Table 2, were chosen based on the results of previous studies (Antill, Cotton, Russell, & Goodnow, 1996; DeLucia, 1963; Walker, 1964). Activities were chosen by the same judges used in the development of the GRSQ-P. Each activity was illustrated on a 4" x 5.5" black and white card showing a stick figure performing the activity and the name of the activity.

Table 2

Items used for the GRSQ-A

Masculine	Feminine	Neutral
Skateboarding	Jump roping	Swimming
Playing with laser guns	Making a build-a-bear	Listening to an I-pod
Cutting the grass	Cooking	Watching a 3-D movie
Playing video games	Making greeting cards	Talking on a cell phone

Participants

Twelve children participated in this study, six of whom were boys (mean age= 8.33 and six girls (mean age=8.17). All of the participants were relatives and friends of fac and students from St. Mary's University.

Procedure

Testing was administered in individual interviews. Informed consent was provided both the parent(s) and the child. Children read items in both the CSRI and the GRSQ-P themselves as the primary investigator read the item out loud. The CSRI-typical alway followed the CSRI-self; however, the GRSQ-P test order was randomly assigned. After each statement was read, sufficient time was provided to allow for item completion.

The last measure taken was the GRSQ-A. Each card with its activity was read out-loud. Children were asked to place each activity picture in one of three boxes- labeled "Boys," "Girls," and "Both"- as to which they believed best described boys, girls, or both boys and girls.

Results

The differences between boys and girls on the measures of personal attributes, alon with the means are presented in Table 2. Based on visual inspection of the data, there may be a positive association between the CSRI-typical femininity and the GRSQ-typ femininity. There may be an association between the CSRI-typical masculinity and the GRSQ-typical masculinity, though not as strong as for the femininity scores. There ma also be an association between the CSRI-self femininity and the GRSQ-typical femini ity. However, no association was observed between The CSRI-self masculinity and the GRSQ-typical masculinity.

Table 2

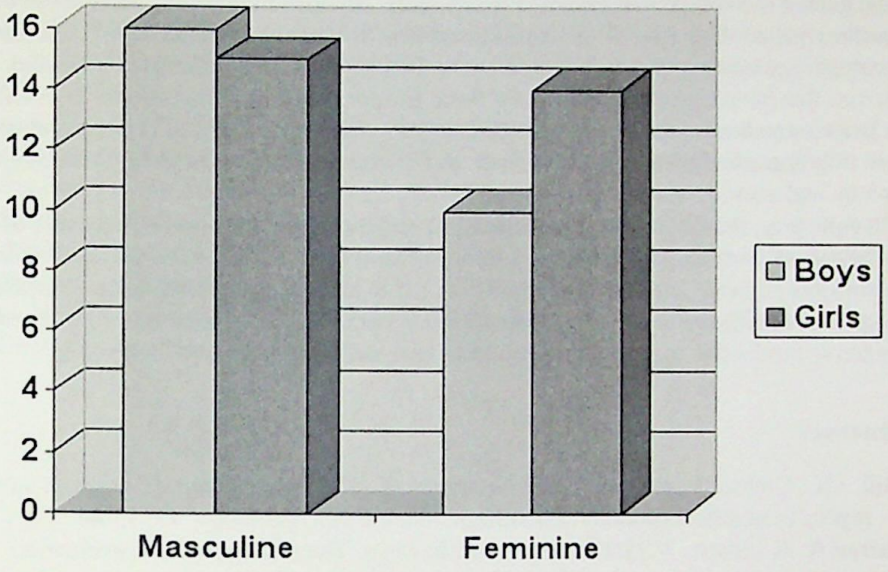
Gender Differences on both measures of the CSRI- self and CSRI-typical and the GRS

Measure	*Boys Mean*	*Girls Mean*	*Total Mean*
CSRI –Self			
Masculinity	2.58	3.00	2.79
Femininity	3.00	3.38	3.19
CSRI- Typical boy/ girl			
Masculinity	3.50	3.17	3.34
Femininity	3.00	3.29	3.15
GRSQ-Typical boy/girl			
Masculinity	3.17	2.75	2.96
Femininity	3.04	3.46	3.25

Activities

The number of gender-role stereotyped activity choices boys and girls made is illustrated in Figure 1. Girls made more gender-appropriate choices for activities for both masculine- stereotyped and feminine-stereotyped activities. Boys made more gender-appropriate choices for masculine stereotyped activities. Overall, boys and girls made more gender-typed choices for masculine stereotyped activities (31) than for feminine stereotyped activities (24).

Figure 1
Boys' and Girls' Choices of Gender-Appropriate Activities



Discussion

The results of this pilot study indicate that the GRSQ-P and GRSQ-A are a promising measure of gender-role stereotyping in middle-childhood children. Although the data were not statistically analyzed due to small sample size, visual inspection of the data suggests the

GRSQ-P is positively associated with the CSRI-typical, indicating that at least for this small sample of children, the two tests are equivalent and are measuring the same construct (i.e., gender-role stereotyping).

Girls made more gender-appropriate choices in the GRSQ-A for both stereotyped masculine and stereotyped feminine activities. Yet, boys chose stereotyped masculine activities as more appropriate for boys than stereotyped feminine activities as appropriate for girls. Activities in the masculinity scale were more stereotyped than activities in the femininity scale among both, boys and girls. A possible explanation for the lessened stereotyping of gender-role stereotyped feminine activities is that the activities chosen for the GRSQ-A maybe mediated by children's real life experiences. For example, if a boy observes his father cooking, he might not develop the gender stereotype that females are chiefly responsible for cooking. In addition, the lessened gender stereotyping for feminine stereotyped activities may reflect societal changes on the gender attitudes.

The finding that for boys, scores on the CSRI-self masculine were lower than scores on the CSRI-typical boy- masculine was interesting, and could suggest that boy's might have issues with self-esteem. Future research is needed to investigate the association between children's perception of the self and that of the typical boy or typical girl and their contribution to gender-role stereotyping.

One limitation of this study was the lack of correspondence between past researches's rating of the activity as masculine-stereotyped, feminine-stereotyped, or neutral and children's (participants in this study) perception of the activity. Video games, traditionally

stereotyped as masculine, and card making, traditionally stereotyped as feminine, were rated more neutral than gender associated. "Talking on a cell phone," however, was viewed as feminine by half of the children. The assumed gender neutrality of this activ may be have been compromised by the word "talking' as children may have been affec by the gender stereotype that girls like to talk/chat. Another limitation of this study concerns the methodology used to determine activities as masculine-stereotyped, feminine-stereotyped, or neutral. In future research, the GRSQ-A will be redesigned to include activities that have empirical support for these gender based determinations. In additio this study's small sample size prohibited definitive conclusions and future research nee to not only include more children but to examine a more diverse group of children as to ethnicity and socio-economic status.

In summary, the GRSQ-P and the GRSQ-A appears to be a promising measure of gender-role stereotyping in children. Children found the content of the GRSQ-P to be derstandable and easy to follow and the GRSQ-A to be especially enjoyable. Children' perception of self may be different than their perception of the typical boy or girl and it may prove productive to assess perception of both self and other.

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Multiple Rate Process Analysis of Thermal Damage

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Abstract

Theoretical modeling and analysis may be used to better understand the complex proc involved in the laser coagulation and optimized the dosimetry of laser thermotherap full dynamic theoretical model was developed to simulate the dynamic evolution of agulation in tissue, which accounted for the dynamics of the temperature and dam dependence of optical properties, thermal properties, and blood-perfusion rate.The BT thermal model is a 1-D and 2-D cylindrical coordinate system simulation of optical ra tion and radio frequency thermal interaction with tissues. The model takes its name f the four primary authors of the model, Buffington, Thomas, Edwards, and Clark, altho many others have contributed.[2]

Introduction

Kinetic models of thermal damage in tissues can be used to describe pathologic end points obtained with laser irradiation. Many treatment end-point goals involve relativel low temperature coagulation of tissue, and these end points can be described by rate process models. Thermal damage is exponentially dependent on temperature and linear dependent on time of exposure. In order to be useful in evaluating laser dosimetry, the kinetic model must be coupled to quantitative pathological analysis. Finite-difference n merical methods are employed in the solutions of heat transfer. An alternating-direction implicit (ADI) finite-difference method is employed in the solution of the heat equation in 2-D, while a Crank-Nicholson method is employed in the 1-D solution. The BTEC simulation can be configured with a source term defined by a single or by multiple emitters, such as laser, RF, or broadband. The BTEC can also compute a source based on the initial electric field profile and a refractive index distribution.

The tissue simulation is represented as a one-dimensional stack of homogeneous layers along the z-axis. Each layer can have differing thermal, optical, and physical properties. The linear absorption coefficient of each layer defines the energy transfer from the optical source to the tissue. Boundary conditions along the axial and radial (2-D) coordinates may be selected as a sink (temperature held constant) or as a combination of surface boundary conditions (convection, radiative, or evaporative).

The BTEC model currently employs a single rate-process model of thermal injury. User-defined parameters for damage rates and activation energies as a function of temperature can be programmed for each tissue type or layer used. A number of damage integral values or temperature shift searches are available in order to estimate damage thresholds or for comparison to experimental data.

Arrhenius Integral

The current BTEC heat-transfer and thermal injury model produces a solution to the 2-D heat equation that provides an approximate time-dependent solution of the form T (z, r, t) giving the temperature distribution in cylindrical coordinates at a specific time. At each point within the computational space, the model continually updates a running sum of the Arrhenius integral given below:

$$\Omega(z, r, \tau) = A \int_0^{\tau} exp\left(\frac{-E_a}{RT(z, r, t)}\right) dt \qquad (1)$$

In the computational space z and r are indexed by (i, j) in a fixed coordinate space such that the values may be indexed as

$$\Omega_{i,j}(\tau) = A \int_0^{\tau} exp\left(\frac{-E_a}{RT_{i,j}(t)}\right) dt \,. \qquad (2)$$

Currently, this equation is evaluated using the trapezoid method. For a given coordinate, the i, j labeling is ignored, yielding

$$\Omega(\tau + \Delta t) = \Omega(\tau) + \frac{1}{2}\left| exp\left(\frac{-E_a}{RT(\tau + \Delta t)}\right) + exp\left(\frac{-E_a}{RT(\tau)}\right)\right| \,. \qquad (3)$$

This method suffers from errors as the integrand varies rapidly, and the two points of evaluation are weighted equally, essentially linearizing an exponential function. If this function varies such that the equality in Equation 4 is not a valid approximation, then the integral is not accurate.

$$exp\left(\frac{-E_a}{RT(\tau)}\right) \approx 1 + \left(\frac{-E_a}{RT(\tau)}\right)\tau \qquad (4)$$

Current Damage Integral

The C code shown below is a computational version of the Arrhenius rate process model, where A is a frequeny factor, t the total heating time, E an activation energy barrier, R the universal gas constant and T the absolute temperature. A and E are user defi and can be found experimentally.

```
using namespace std;
int main(int argc, char *argv[])
{
std::string inputFilename = "Tvst.dat";
double *t, *T, *Y;
int n;
std::ifstream inFile(inputFilename.c_str());
FunctionDataFiles::readDataFile(t,T,n,inFile);
inFile.close();
Y = new double[n];
printf("%lf %lf",A,E);
for(int i=1;i<n;i++)
{
T[i]=T[i]+300;
cfPtr1 = fopen("Tvstoutput.dat","w");
cfPtr2 = fopen("Current_Rate_Process_Model.dat","w");
cfPtr3 = fopen("output.dat","w");
integral = 0;
for(int i=0;i<n-1;i++)
{
dt= (t[i+1]-t[i])/2;
inside_exponent = (-E/(R*T[i]));
inside_exponent2 = (-E/(R*T[i+1]));
Exp1 = exp(inside_exponent2);
Exp2 = exp(inside_exponent);
integral+=A*(dt*(Exp1+Exp2));
fprintf(cfPtr1,"%lf %lf\n", t[i],T[i]);
fprintf(cfPtr2,"%lf %lf\n", t[i],integral);
}
fclose(cfPtr1);
fclose(cfPtr2);
fclose(cfPtr3);
}
}
```

After running the code, we acquire a graph that looks like figure 1: The graph shows an S curve. What this represents is the cell viability or cell death depending on time dependent temperature.

Replacement Damage Integral

The code below is the start of a replacement damage model. This has not been tested or implemented. Assumptions have been made to acquire the final result. Numerical Recipes was used to find the integral of exp(x)/x.

```
using namespace std;
int main(int argc, char *argv[])
{
double m[i],x[i],dx[i],x_prime[i],dx_prime[i];
                std::string inputFilename = "Tvst.dat";
                double *t, *T, *Y;
                int n;
                std::ifstream inFile(inputFilename.c_str());
                FunctionDataFiles::readDataFile(t,T,n,inFile);
                inFile.close();
                Y = new double[n];
                printf("%lf %lf",A,E);
                for(int i=1;i<n;i++)
                { T[i]=T[i]+300;
                cfPtr1 = fopen("Tvstoutput_replacement.dat","w");
                cfPtr2 = fopen("Replacement_Rate_Process_Model.dat","w");
integral = 0;
for(int i=0;i<n-1;i++)
{ m[i]=(T[i+1]-T[i])/(t[i+1]-t[i]);
T[i]=m[i]*t[i]+T[i];
x[i]=1/T[i];
dx[i] = pow(-x[i],-2)*m[i];
x_prime[i] = (-E/R)*x[i];
dx_prime[i]=(-E/R)*dx[i];
integral+=A*(E/(m[i]*R))*(((exp(x_prime[i])/x_prime[i])-
(exp(x_prime[i+1])/x_prime[i+1]))+(NR::ei(x_prime[i+1])-NR::ei(x_prime[i])));
fprintf(cfPtr1,"%lf %lf\n", t[i],T[i]);
                fprintf(cfPtr2,"%lf %lf\n", t[i],integral);
}
fclose(cfPtr1);
fclose(cfPtr2);
}}
```

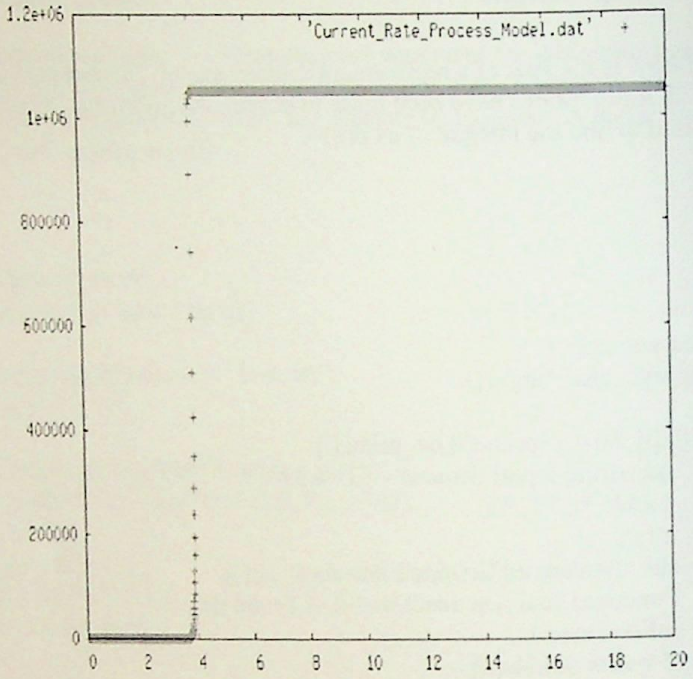

Figure 1: An Illustration of the Arrhenius model.

Conclusion

Obviously, improved methods are needed to accurately depict short-pulse damage thresholds, where temperature rise is significant during a time step. That is the rate of change of the damage rate (second derivative of damage integral) is significant.[3] The replacement damage model has yet to be tested to see if it yields the same results as the Arrhenius model, but the analytical results look promising.

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Studying the Effects of Interactive Engagement on Student Performance

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Abstract

From 2000 to 2007 students information on their SAT/ACT, overall grade in a first year physics course, a given pre-test and post-test and the gain calculated between the two were taken. A measure of whether or not the first year physics course was taken in an Interactive or non Interactive fashion was also taken. Through this study, we chose to study the effects of SAT/ACT math scores on overall grades when selecting for either/both class type and gender. We also measured the differences in the Pre-Test and Post-Test scores based on gender, as well the differences in the gain score between both the students gender and class type. The SAT scores were a significant predictor of male performance in a course in both the Interactive and Non-Interactive courses though more so for the Interactive. ACT scores were a significant predictor of overall grade for females in the Interactive environment only. Pre-test scores were comparable for both genders in both class types. In the Non-Interactive courses, post-test scores were significantly higher for males when compared to females. In the Interactive courses, the scores between both genders were not significantly different. Overall, those in the Interactive courses had significantly higher post test scores than those in the non-Interactive courses.

Introduction

Typically when entering a classroom, an instructor will have a set teaching style. Usually these styles can be set into one of two categories, interactive (IE) and non-interactive (NIE). Interactive classes can contain a myriad of different activities to foster learning. For example, interactive courses can contain not only traditional lectures, but also group discussion, hands on activities, and other applicable constructs. Non-Interactive courses are typically limited to only traditional lectures.

According to Zirkin and Sumler (1994), interactivity, both in distance learning and

traditional classroom instruction plays an important role in student achievement, regardless of the style of interactivity introduced. Mohanan (2005) states that most people would agree, that all else being equal, Interactive teaching is likely to trigger better learning that Non-Interactive teaching. McFadden (1991) shows that meaningful student engagement was only 48% in Non-Interactive courses. On the other hand, Interactive classes were judged to have 76% of the students meaningfully engaged. Adding small group discussion to an Interactive course raises meaningful student engagement to 80%.

Cheng, Thacker, Cardenas, and Crouch (2004), conducted a study testing the effects of online homework on a student's learning of physics concepts. For the purpose of that study, online homework was given to a select group of students. This homework gave immediate feedback and a grade following completion. Other students were given traditional homework with no grading or feedback offered, with the exception of a short quiz based on the assigned homework. This online homework group was found to have significantly higher performance than was the traditional homework group (Non-Interactive) based on the normalized gain calculated between the pre and post tests.

For this study, several different student evaluation methods were studied on the basis of whether or not they were enrolled in an Interactive or Non-Interactive course. The Interactive courses consisted of clicker questions (also known as polling systems), white board problems, and online homework. Clicker questions are a series of timed, conceptual questions projected onto a screen. Each student has a handheld control unit which allows them to pick what they deem to be the best response for each question. Once the time limit expires, a graph showing the distribution of answers is projected onto the screen along with the correct answer. These responses are completely anonymous which elicits 100% participation. After the correct answer is posted, a brief discussion ensues regarding the wrong answers as well as the right answer. The most important feature of this method is the discussion during and after the question is asked. The students are allowed to discuss their selections with each other while the time counts down, which always leads to very lively discussions.

The whiteboard problem sessions allow students to gather in groups of three or four to collaborate to solve the problem. In the past, the professor would print out a worksheet document and proceed to solve all of the problems for the students. In this new method the professor would only perform one or two examples related to the current topic. Then the worksheets are turned over to the students who work in groups to solve the problems. This type of peer instruction is important to the learning process because the process of thinking through to the problem's solution is the sole responsibility of the student. The professor was available to lend a helping hand if students have any issues with problems.

Another critical feature of the Interactive method is the online homework system. The system used was the Mastering Physics program. The homework was assigned twice a week (or after each lecture period) reviewing the concepts that were covered in class during that previous lecture. The program was completely Interactive. When students encounter problems, they can work through a series of hints to help them solve the problem. These hints are mini problems that guide them through the problem solving process step-by-step. In addition, the student has seven attempts to answer the question. Usually after the first miss, the student either uses the hints, visits the professor during office hours, or attends the tutorial session. The program deducts points for every hint used as well as for every missed attempt.

Non-Interactive classes consist of traditional lecture with minimal student input beyond the occasional question from a student or a general question posed by the instructor. In these courses, none of the Interactive activities are present. Professors will lecture for the duration of the course, usually using prefabricated lecture notes or a PowerPoint

During this time, students may be asked to comment or answer questions but not to the level of engagement that is present in the Interactive courses.

Materials and Methods

The Force and Motion Concept Evaluation (FMCE) pre-test/post-test is an examination given to first year physics students to evaluate learning during the course. It is a research-based, multiple choice test designed to assess understanding of Newtonian Mechanics (Thornton & Sokoloff, 1997). Ramlo (2002) set out to assess the validity of this exam using fifty-four students from C&T in the Fall of 2002. The original pilot study estimated the reliability of the FMCE at 0.50 for the pre-test and 0.94 for the post-test. Ramlo's results yielded overall Cronbach's alpha reliability of 0.54 (pg 9). A test is seen as reliable if the obtained Cronbach's alpha is 0.9 or higher (Newman and Newman, 1994). Thus, with a reliability of 0.94 at the post-test, the FMCE contains sufficient reliability to be seen as a valid measure.

The data used covered examinations conducted on students in both Physics 1401 and Physics 1404 at St. Mary's University in San Antonio, Texas. According to the St. Mary's University Undergraduate Catalog, Physics 1401 (General Physics), is described as the basics on mechanics, sound and heat. This course is intended for non-physics and non-engineering majors only. Physics 1404 (Mechanics, Heat and Acoustics) is intended for physics and engineering majors, covering the same topics as physics 1401 but with calculus as the base mathematical method. For both courses, the pre and post tests were administered at about the same time. Pre-tests were administered during the first full class week. As previously stated, this test was used as the baseline for each student to measure gain in physics knowledge over the semester. Post- tests were administered during the last week of classes before the final exam. A gain was calculated between these two scores for each student. This gain score is the ratio of absolute gain to the maximum possible gain multiplied by 100 (Cheng, Thacker, Cardenas and Crouch, 2004). Below is the calculation used in order to obtain this gain score where, S represents the final pre or post- test score and g in the normalized gain between the pre-test score and a perfect score of 100.

$$g = \frac{S_{Post} - S_{Pre}}{100 - S_{Pre}} \times 100$$

For each student, many different types of data were gathered in order to analyze the full spectrum of the effects of Interactive and Non-Interactive courses. General demographic data for each participant was present including their first and last name, student ID and gender. Previous research has indicated that a student's SAT scores can be used as a valid predictor of college success, though much more so for minority groups than Caucasian students (Seattle Times, 2008). Due to the largely diverse population at St. Mary's University, SAT math scores were gathered for all participants. Table 1 shows the breakdown of demographics at St. Mary's based on ethnicity. St. Mary's University does allow admission based on either the ACT or SAT (though the SAT is more common), so ACT math scores were gathered in place of the SAT for those participants who did not participate in the SAT.

Table 1: St. Mary's University Demographics

Race/ Ethnicity: Total Enrollment	Number	Percent
International	133	3.40%
Black, Non-Hispanic	141	3.60%
American Indian/ Alaskan Native	12	0.30%
Asian/ Pacific Islander	117	3.00%
Hispanic	2,098	53.50%
White, Non-Hispanic	1,184	30.20%
Other/Unknown	235	6.00%
Total	3,920	100%

[1] Data obtained from St. Mary's University Registrar's Office
[2] Demographics based on 2006 student population

St Mary's University uses a nine-point, plus/minus grading scale in place of the traditional five point grading scale used at many other universities, as evidenced by Table 2. Both the letter grade and grade according to the grading scale were used for each participant. Lastly, the pre and post-test scores and the gain calculated between the two, are present for each participant.

Student information was analyzed using the SPSS program. Participants were all students at St. Mary's University during the 2000-2007 school years. In order to be a member of this study, students had to have either completed Physics 1401 or Physics 1404 within this date range. For students who took these courses multiple times, the scores for their first attempt at the course were utilized due to the possibility of a learning effect in subsequent attempts. First, Pearson's Correlations were run to test the relationship between all of the variables of interest. Following this, independent samples T-Tests were run on both the pre and post-test scores alternating the grouping variable from gender (male and female) to class type (Interactive and Non-Interactive). Linear regressions were also run on multiple constructs. The first set of tests tried to determine the predictability of the SAT math scores on overall class grade when selecting for gender, class type or both. The second set of tests tried to determine the predictive ability of the ACT math scores on overall class grades when selecting for gender, class type or both.

Table 2: St. Mary's University Grading Scale

Letter Grade	G.P.A.
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C	2.00
C-	1.67
D	1.00
F	0.00

Results

Initial correlations were run in order to determine if the relationship between items was as theorized. Table 3 shows the relationships between the pre-test, post-test and gain scores as well as the correlations between the ACT math, SAT math, and GPS variables. A high correlation between the SAT and ACT math scores indicated possible colinearity. For the purpose of this study, this possible colinearity indicates that these two variables are measuring a percentage of the same construct, thus indicating that the ACT scores are an valid replacement for SAT scores when they are not present for an individual.

Table 3: Correlations for basic variables

	Pre-Test	Post-Test	Gain	ACT Math	SAT Math	GPS
Pre-Test	1.000					
Post-Test	0.419	1.000				
Gain	0.171	0.940	1.000			
ACTMath				1.000		
SATMath				0.746	1.000	
GPS				0.495	0.502	1.000

Independent samples *t*-tests were run to see if there were significant differences in the mean pre-test and post test scores between Interactive and Non-Interactive class types. When comparing the pre-test scores, Interactive and Non-Interactive class types had comparable means at 22.09 and 21.97 respectively. The *t*-test was not significant (t= -.077, n.s.), indicating that there were no significant differences between the class types on pre-test scores.

When comparing the post-test scores, on average, the Interactive class type (M= 656.10, SD= 22.21) had higher post-test scores than the Non-Interactive class type (M= 386.60, SD= 14.43). Due to a significant Levene's Test (p= .015), equal variances could not be assumed. The difference between the Interactive and Non-Interactive class types were statistically significant

(t= -12.205, p= .000), indicating that the FMCE is a measure of knowledge gained during a physics course. The Interactive class environment fosters significantly more learning during the semester than the Non-Interactive class environment.

A cross tabulation was run comparing the post-test scores and the class type. The numbers of responses in each category were divided by the total number of responses for that score to yield a percentage. Charting these percentages indicates that an Interactive class environment has a positive trend line (more people tended to get higher grades on the post-test) while the non-Interactive class had a negative trend line (more people tended to get lower grades on the post-test). Figure 1 shows the plot and trend line for the Interactive courses and Figure 2 shows the plot and trend line for the Non-Interactive courses.

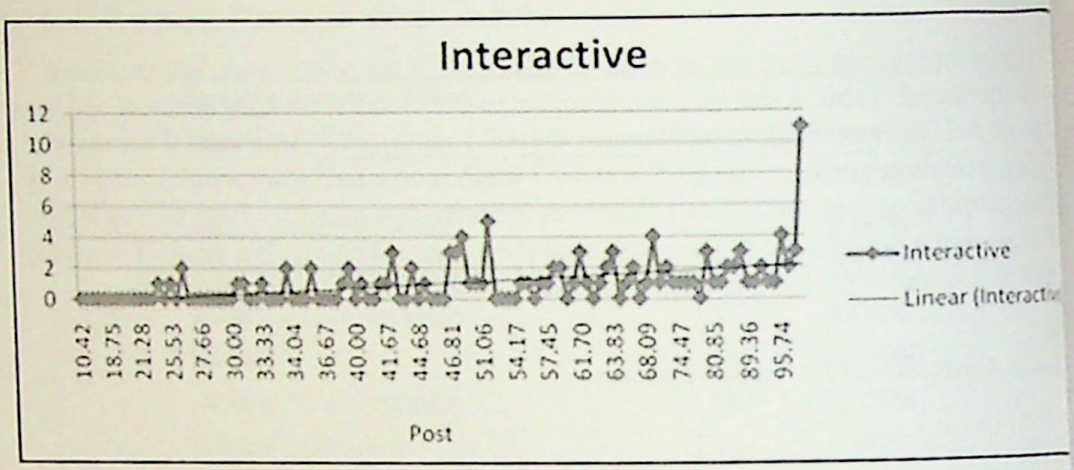

Figure 1: Crosstab Percentages (Interactive X Post)

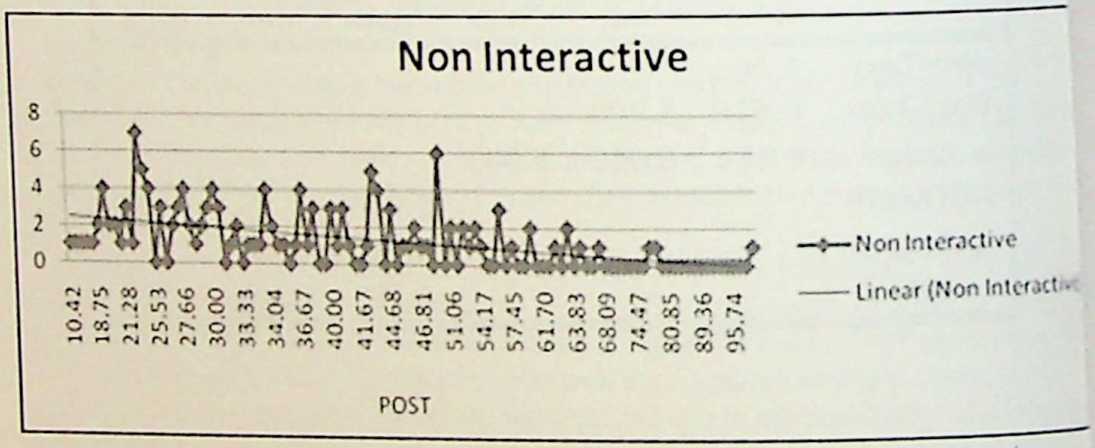

Figure 2: Crosstab Percentages (Non-Interactive X Post)

Two further Independent samples *t*-tests were run on the pre and post tests using gender as the grouping variable. When comparing the pre-test scores between males and females, males (M=24.57, SD=13.56) tended to have higher pre-test scores than females (M=20.46, SD=10.32). A significant Levene's Test (p=.015), indicates that equal variances could not be assumed. The difference between the females and males pre-test scores was statistically significant ($t(164)=2.567$, $p<.05$), indicating that in this sample of first year physics students, males tended to have more knowledge in the subject area than their female counterparts.

The result of the Independent samples *t*-test comparing post-test scores yields similar results. When looking at these scores, males (M=54.70, SD=24.29) tended to have higher post-test scores than females (M= 46.66, SD= 22.42). Levene's Test for Equality of Variances was not significant, meaning equal variances could be assumed. The difference in post-test scores between males and females was statistically significant (t (252) =2.689, $p<.01$). This is a larger difference in means when compared to the pre-test scores (a 4 point difference in the pre-tests compared to an 8 point difference in the post-tests).

Further analysis was run, comparing the post-test scores across genders while selecting for class types. For those in the Non-Interactive class, there remained a significant difference between males (M = 41.18, SD=15.50) and females (M=34.38, SD=13.41), (t (139) =2.679, $p<.01$. For those in the Interactive class, there was no significant differen

found between males (M=66.88, SD=24.43) and females (M=65.46, SD=20.37) post-test scores (t (97) =.334, n.s.).

Due to the high correlations between the SAT and ACT math scores and GPS (overall grade for first physics course), regression analyses were run in order to assess the predictive ability of these tests on the student's GPS score when selecting for gender. Follow-up linear regressions were run, also selecting for class type (IE and NIE). Both tests were found to be significant predictors of overall grades across both genders when class type was not analyzed. Table 4 shows the results of these general analyses.

Table 4: Regression analysis over both class types

Test	Gender	R	R^2	sig.
SAT-Math	Male	0.576	0.332	0.000
SAT-Math	Female	0.363	0.132	0.001
ACT-Math	Male	0.582	0.339	0.005
ACT-Math	Female	0.465	0.216	0.000

The same four comparisons were run selecting for the NIE class type. Unlike the previous analysis, the only significant predictor of overall grades was the SAT math tests for male students. As a predictor, the SAT math test shows a sizeable proportion of the variance for male students, R=.471, R^2 = .222, F (1,17) = 4.857, p<.05.

When running the same tests for the Interactive class type, all four tests were again significant. For males, the SAT math was a significant predictor of overall grades, again with a much higher proportion of the variance explained when compared to the NIE class type, R=.631, R^2=.398, F(1,34) = 22.512, p<.01. The ACT score was also a significant predictor of overall physics grade for males, R=.591, R^2=.35, F(1,12)=6.457, p<.05.

For females, the SAT math score was also a significant predictor of overall grade, with 46.5% of the variance in the sample being accounted for by it alone. As a predictor, the SAT math score was significant at the .01 level, and the overall regression analysis was significant at .004. When looking at the ACT math scores as a predictor of overall physics grade, a tremendous amount of the variance is shown by this predictor, R= .673, R^2=.453, F(1,21)=17.424, p<.001.

Discussion

Overall, results represented not only the same patterns found in the literature, but supported our hypothesis that predictive ability and test scores would be significantly higher for the IE (Interactive) class type than for the Non-Interactive class type.

An interesting result of the t-test examinations was the differences between males and females as well as class types. Pre-test scores across both genders were nearly even for both class types, but there was a significant difference between post test scores, with the Interactive class types mean score being an excess of 30 points higher than that of the Non-Interactive class. Gender differences were also present and were severely affected by the type of class in which the student was enrolled. Over both class types, males had higher average scores than females on both the pre and post-tests. When looking at

the post-test scores between the two class types, there were no significant differences between the male and female groups in the Interactive classes, while the males in the Non-Interactive course showed significantly higher post-test scores than females. This indicates that, on par with the literature, students benefit from an Interactive classroom environment. The use of a Non-Interactive class environment amplifies the deficiency o the females' scores when compared to males' on the overall analysis, taking it from a 4 point difference on the overall pre-tests to an 8 point difference on the post-tests scores. On the other hand, though the deficit existed on the pre-test scores, post-test scores in the Interactive classroom environment were not only significantly higher than their NIE counterparts, but they eliminated the large score difference between the males and females, leaving only an insignificant point spread of 1.42 points.

Since colleges use the SAT and ACT scores to gauge whether or not a studen should be admitted, it is satisfying to find that they are significant predictors of college success. It was very interesting that across both class types, these tests were able to predict between 36% and 58% percent of the variance in the sample. Further proof of th deficiency in the NIE courses, upon selecting for those who were solely in these course only the males overall scores could be significantly predicted, and only when using the SAT math as a predictor. Both tests across both genders again became significant predic- tors of overall scores in the physics course when the Interactive class type was selected. The level of prediction was also higher than the overall prediction, with these tests bein able to predict 47% to 67% of the variance within the sample. Interestingly enough, the SAT and ACT math scores had almost the same predictive ability for males, with the SA (R=.631) predicting only 4% more variance than the ACT (R=.591). When looking at these tests for females, it becomes very clear that within this sample, the ACT is a better predictor of overall grade in the physics course than the SAT, which predicted only 46.5 of the overall variance while the ACT predicted 67.3% of the variance in the sample.

Limitations and Future Directions

Though there were a high number of students represented for each comparison, the tendency for most students was to take the SAT test as opposed to the ACT test. The College Board published a conversion table in order to allow for comparisons between the two tests. In future analysis, it may be of interest to convert the SAT scores into the ACT score format to allow for a comparison of all members in the study, as opposed to comparing between the two tests types. The conversion must be from SAT to ACT scores, as the conversion chart shows only a single ACT score representing a range of SAT scores, therefore making conversion to SAT impossible. Another interesting factor consider is the implementation of the new SAT. All participants in this study took the ol SAT, which was devoid of a writing section. The addition of this may change the way th exam is scored and thus the analysis method. Finally, the addition of laboratory work m be of interest, as some students were subject to an Interactive class but a Non-Interactive lab and vice-versa.

Conclusion

It is important for colleges/universities to consider their method of instruction. Though some student's are able to persevere regardless of instructor and material, it is important to note that with the implementation of Interactive courses at an institution of higher learning could not only predict a student's possible success, but make them more successful. When it comes to class types, literature and this analysis have supported the notion that a Non-Interactive environment results in less learning and lower scores overall. Conversion of classes to Interactive styles would not only raise success rates in

courses but help students learn the material to a higher degree, thus preparing them better for future courses and careers.

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The Role of RAGE and NFκB in Schwann Cells as Contributors to the Developments of Diabetic Neuropathy

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Abstract

Diabetic neuropathy is a condition characterized by the loss of sensation and muscle weakness in the extremities. The underlying molecular mechanisms associated with diabetic neuropathy are not well understood; however, nonenzymatic glycosylation, which results in the formation of advanced glycation end products (AGEs), is known to alter the function of numerous proteins after prolonged exposure to elevated levels of glucose. At high concentrations, AGEs bind to the receptor for advanced glycation end products (RAGE) and activate NFκB which is a transcription factor involved in the expression of genes associated with the inflammatory response in cells. Prolonged inflammation could be responsible for the death of Schwann cells in peripheral nerves, which may be a contributing factor in the development of diabetic neuropathy. Immuncytochemical and western blotting analyses were used to determine if RAGE and NFκB were present in Schwann cells exposed to elevated levels of glucose.

Introduction

Diabetes Overview

Diabetes mellitus is a common and major chronic disease which affects 20.8 million children and adults in the United States as well as 7% of the world's population (American Diabetes Association). Diabetes mellitus is characterized by elevated glucose levels as a result of inadequate or inefficient production of insulin by the pancreas. Before, during, and after periods when an individual consumes food, blood glucose levels rise and signals are sent to the pancreas to release insulin. Insulin is a hormone that allows glucose to enter cells where it is an important source of energy for the body. However, if insulin levels stay low, a person has an increased chance in developing diabetes mellitus because glucose cannot enter cells and remains in the blood (Kalat, 2007). There are two known

forms of diabetes mellitus, type 1 and type 2. Type 1 diabetes mellitus or insulin dependent diabetes occurs when the pancreas does not produce the hormone insulin. The person's immune system attacks and destroys beta cells in the pancreas. This destruction off beta cells is what ultimately stops the ability of the pancreas to further make insulin (Kids Health, 2007). Type 2 diabetes mellitus or non insulin dependent diabetes is a form off diabetes where the body's pancreas cannot produce a sufficient amount of insulin that a person's body needs to break down glucose (Kids Health, 2007). Genetics and environmental factors such as a person's eating habits and exercise can be huge contributors to the development of diabetes mellitus but the cause of diabetes mellitus is yet unknown (American Diabetes Association). Constant elevated levels of glucose (hyperglycemia) are a major problem due to the fact that elevated levels of glucose can ultimately lead to many complications, such as blindness, kidney failure, neuropathy, and ultimately death.

Diabetic Neuropathy-what is it and what causes it?

Diabetic neuropathy is a complication due to diabetes where both autonomic and peripheral nerves are damaged from prolonged elevated levels of glucose (hyperglycemia) (Wada and Yagihashi, 2005). Damage to these specific nerves results in the degeneration and loss of sensory fibers that meditate pain and temperature fibers or may lead to hypersensitivity of sensory fibers (Dobrowsky, et al., 2004). There are many factors that may lead to the development of nerve damage during prolonged exposure to elevated glucose levels such as circulatory problems, oxidative stress, and inflammation. Elevated glucose levels causes circulatory problems by changing the metabolism of nerve cells which in turn reduces the blood flow to the nerves (Diabetic Foot Disease). Loss of adequate blood flow to major arteries leads to pain and discomfort in limbs and feet and as a result of poor circulation of blood flow to nerves, ultimately results in diabetic neuropathy (Diabetic Foot Disease). Research also suggests that elevated glucose levels leads to oxidative stress because high glucose levels triggers the polyol pathway where there is extra glucose floating freely across the cells (Dobrowsky, et al., 2004). This creates apoptosis (cell death) due to the extra elevated levels of glucose. Lastly, nuclear factor-kappa beta (NFκB) activates genes leading to inflammation and as a result of prolonged exposure to AGEs, NFκB activation may result in insulin resistance. This is also associated with diseases such as atherosclerosis and other vascular disorders which may result in additional circulatory problems (Hudson, et, al., 2002).

There has been a huge amount of research that focuses on neurotrophic factors such as nerve growth factors as potential therapeutic treatments for diabetic neuropathy. These growth factors are a group of proteins that promote and mediate the growth and survival of neurons. In elevated glucose levels however, the myelin (material composed of fats and proteins that accelerate electrical transmission in axons) is lost which reduces electrical signaling between nerves (Dobrowsky, et al., 2004). Myelin is produced by Schwann cells in the peripheral nervous system and is essential for the proper signaling between neurons. As previously stated, research has mainly focused on nerve growth factors, however, there is little knowledge or research about growth factors that influence the Schwann cells. One family of growth factors are neuregulins (NRG). NRGs are important for Schwann cell growth, survival, migration, development, and as well as serving as a communicator for neuron-neuron and neuron-glial interactions (Esper, et al., 2005).

Impairments to the NRG signaling pathway may result in Schwann cell dysfunction that could result in the loss of myelin which could have a negative impact on nerve function. NRGs can become nonfunctional due to the high concentration of glucose which results in the formation of advanced glycation end products (AGEs). AGEs are formed due to the nonenzymatic glycation of proteins including NRGs that could contribute to

the development of diabetic neuropathy (Yan, et al., 1997). Therefore, elevated levels of glucose alter the structure of the NRG proteins leading to Schwann cell death and demyelination resulting in diabetic neuropathy. At high concentrations, AGEs bind to the receptor for AGE (RAGE) and as a result, inhibit RAGE from performing their normal function which is to help in Schwann cell growth, survival, migration, and communication. By doing so, AGEs interact and bind with a specific cell-surface sites, which disrupts communication between cells and their receptors (Yan, et al., 1997). This high concentration of AGEs in Schwann cells may lead to the development of organ complications. RAGE has been known to activate a number of downstream effector molecules following AGE binding (Singh et al., 2001). One of the many molecules that RAGE activates is the transcription factor nuclear factor-kappa beta (NFκB). NFκB regulates the expression of a number of genes involved in the inflammation and immune response pathways (Wada and Yagihashi, 2005). The prolonged activation of NFκB by RAGE has been linked to numerous disease states associated with abnormal inflammatory and/or immune responses such as atherosclerosis and Alzheimer's disease, and has been implicated in contributing to a number of complications associated with diabetes including diabetic neuropathy (Hudson et al., 2002).

Therefore, the purpose of the present research is to examine if Schwann cell death may be due to the increased presence of RAGE and the activation of NFκB as a result of elevated levels of glucose, which may contribute to the development of diabetic neuropathy.

Materials and Methods

Schwann Call Cultures

Schwann cells were obtained from the sciatic nerve of post natal day 2 rat pups using the method of Brockes et al. (1979) previously utilized in our laboratory (Raabe et al., 1996). Fibroblasts were eliminated by cycling the cultures with 10 μM cytosine arabinoside (ara-C, Sigma) every 2 - 3 days followed by 6 hours off ara-C. After approximately one week of treating with ara-C, cell cultures were composed of approximately 95% Schwann cells. The Schwann cells were then plated at a density of 15,000 cells/ml on cover slips contained within a 24-well cluster or at a density of at least 350,000 cells/ml in each well of a 6-well cluster.

Immunocytochemistry of Cultured Schwann Cells

Schwann cells were incubated in serum-free media (N2) consisting of high glucose DMEM, Ham's F-12 nutrient mix, L-glutamine, PPN (progesterone, putrescine dihydrochloride, and sodium selenite), insulin, and transferrin, in N2 supplemented with 25 mM D-glucose, or in N2 supplemented with L-glucose or 3-O-methyl-D-glucopyranose (osmotic control) for a time period of 3, 5 or 7 days. The cells were then fixed using 4% paraformaldehyde in PBS for 15 minutes at 4°C. The fixed cells were incubated with a goat anti-rabbit NFκB antibody and a goat anti-mouse RAGE antibody. Then, the fixed cells were incubated with secondary antibodies conjugated to either FITC or TRITC for 1 hour at room temperature. The coverslips were mounted on slides using SlowFade® reagent (Molecular Probes) to prevent photo bleaching and were photographed using a Olympus BX60 epi-fluorsescent microscope equipped with an Olympus camera.

Western Blotting of Schwann Cell Lysates

Schwann cells were incubated at 37°C for 3, 5, or 7 days in serum-free media N2, in N2 supplemented with 25 mM D- glucose or with 25 mM 3-O-methyl-D-glucopyranose

as an osmotic control. Proteins from the whole cell lysates were quantified using a protein assay (Bio-Rad), and 5 μg of total protein were loaded to each well of a 10% polyacrylamide gel. After electrophoresis, proteins were transferred to a polyvinylidene difluoride (PVDF) membrane (Bio-Rad) for western analysis. The membranes were blocked in a solution of 2.5% bovine serum albumin in phosphate buffered saline (PBS) plus .05% Tween-20 for one hour and incubated in the appropriate primary antibody (anti-NFκB or anti-RAGE) overnight at 4°C. Then the membranes were incubated with goat anti-rabbit or goat anti-mouse secondary antibodies conjugated with horseradish peroxidase for 1 hour at room temperature. After extensive washing, immunoreactive bands were visualized by chemiluminescence on Kodak X-OMAT film.

Results

Immunocytochemical and western blotting analyses were performed to determine the effects of elevated D-glucose levels on the expression of RAGE and NFκB in cultured Schwann cells. After 3, 5, and 7 days in culture, the level of immunoreactivity for RAGE and NFκB in Schwann cells incubated in defined media supplemented with 25 mM D-glucose (Figures 1-3, panels B & E) appear to be greater than the immunoreactivity in defined media alone (Figures 1-3, panels A & D) or in defined media supplemented with 25 mM L-glucose to serve as an osmotic control (Figures 1-3, panels C & F). In addition, the data indicates that RAGE is expressed at all time points under all three experimental conditions (Figures 1-3, panels A-C) while NFκB appears to be expressed only when Schwann cells are exposed to elevated D-glucose (Figures 1-3, panel E).

The western blotting assay results are consistent with the immunofluorescence data for RAGE and NFκB. An immunoreactive band corresponding to RAGE is present at all time periods and under all experimental conditions (Figure 4, panel A, arrow). However, an immunoreactive band for NFκB is present in Schwann cells after being incubated in 25 mM D-glucose for 7 days (Figure 4, panel B, lane 8).

Discussion

Previous research has implicated the activation of RAGE and NFκB in the development of diabetic neuropathy in peripheral nerves (neurons and glial cells). In diabetes mellitus, the high concentrations of RAGE and NFκB are involved in the inflammation and immune response pathway, which could lead to insulin resistance (Wada and Yagiashi, 2005). The presence of RAGE in the peripheral nervous system is normal, however, when AGEs are abundant and bind onto RAGE, it activates the downstream molecule NFκB that may lead to the production of cytokines, specifically tumor necrosis factor (TNF) α. This activation and production of these molecules can ultimately lead to cellular dysfunction including cell death via apoptosis. In addition, cytokines are responsible for metabolic alterations due to a weakened immune system which could also result in cellular dysfunction (Feghali and Wright, 1997).

In light of this, our research focused on RAGE and NKκB in Schwann cells, which are one of the two major cell types found in the peripheral nervous system, and their potential role in Schwann cell dysfunction during diabetic neuropathy. Schwann cells are responsible for the production of myelin in peripheral nerves, and myelin is necessary for the proper transmission of electrical signals between neurons. Due to prolonged elevated levels of glucose during diabetes, it has been demonstrated that Schwann cells lose their myelin (Said, 1996). This inhibits proper electrical signaling between neurons. As previously mentioned, NFκB activates the inflammatory pathway which results in the secretion of cytokines. In the peripheral nervous system, the cytokine TNF α causes apoptosis from the activation of NFκB due to elevated levels of glucose (Gozzelino et al., 2008). Our

results indicate that the presence of RAGE and NFκB specifically in Schwann cells. The presence of NFκB in Schwann cells could result in inflammation of the PNS, trigger the release of cytokines specifically TNFα, produce Schwann cell death, and ultimately lead to the development of diabetic neuropathy.

Future Direction

A possible treatment for diabetic neuropathy as a result of the activation of NFκB is neuregulin. Previous research stated that neuregulins are needed for the proper function of the peripheral nervous system due to their role in the development of Schwann cells (Esper et al., 2005). Neuregulins, however, become AGE modified rendering them non-functional. By providing additional neuregulins, it may be possible to prevent or reduce Schwann cell death and the loss of myelin which are characteristic of diabetic neuropathy.

Due to time restraints the current study could not fully examine the activation of NFκB and its production of TNF α in Schwann cells. I suggest that researchers examine and utilize neuregulins as a possible treatment to prevent the inflammatory process and see if it can counteract NFκB and its effects; as well as examine Schwann cells exposed to longer durations in elevated levels of glucose. Some other limitations to the current research includes but not limited to technological difficulties and financial barriers. Nonetheless, these experiments are groundbreaking research for future scientists to continue to study the downstream molecule NF-κB and its production of cytokines on Schwann cells and how it contributes to the development of diabetic neuropathy.

Exhibits

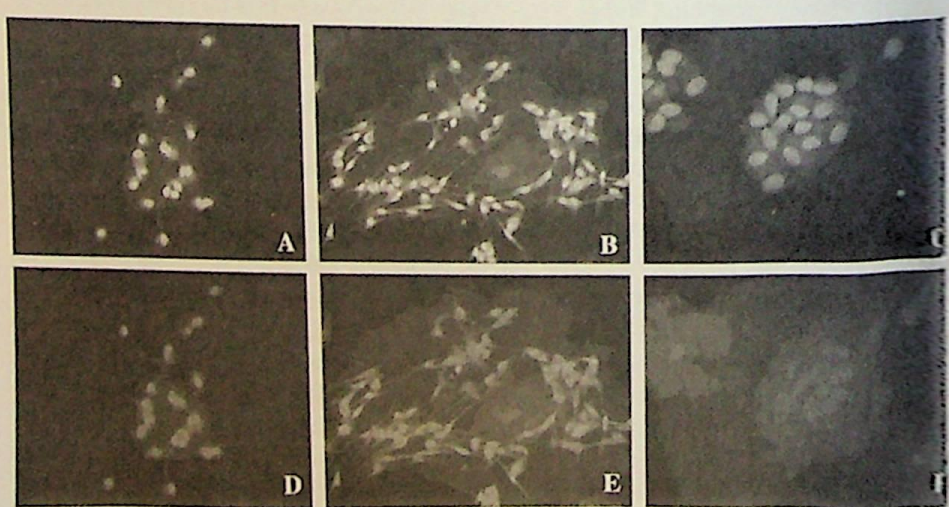

Figure 1: Fluorescent photomicrographs depicting immunoreactivity of RAGE (panels A-C) and of NFκB (panels D-F) in Schwann cells incubated in defined media (panels A & D), in defined media supplemented with 25 mM D-glucose (panels B & E), or in defined media supplemented with 25 mM L-glucose as an osmotic control (panels C & F) for 3 days in culture.

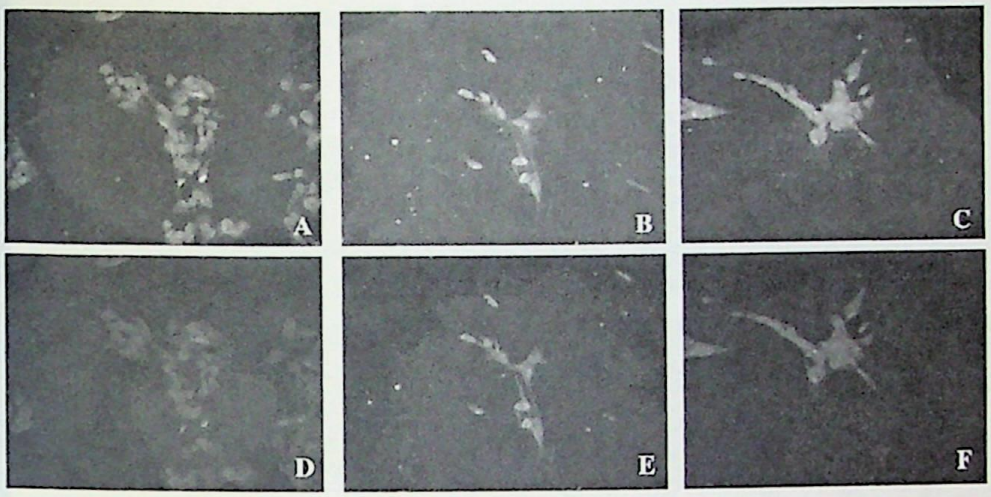

Figure 2: Fluorescent photomicrographs depicting immunoreactivity of RAGE (panels A-C) and of NFκB (panels D-F) in Schwann cells incubated in defined media (panels A & D), in defined media supplemented with 25 mM D-glucose (panels B & E), or in defined media supplemented with 25 mM L-glucose as an osmotic control (panels C & F) for 5 days in culture.

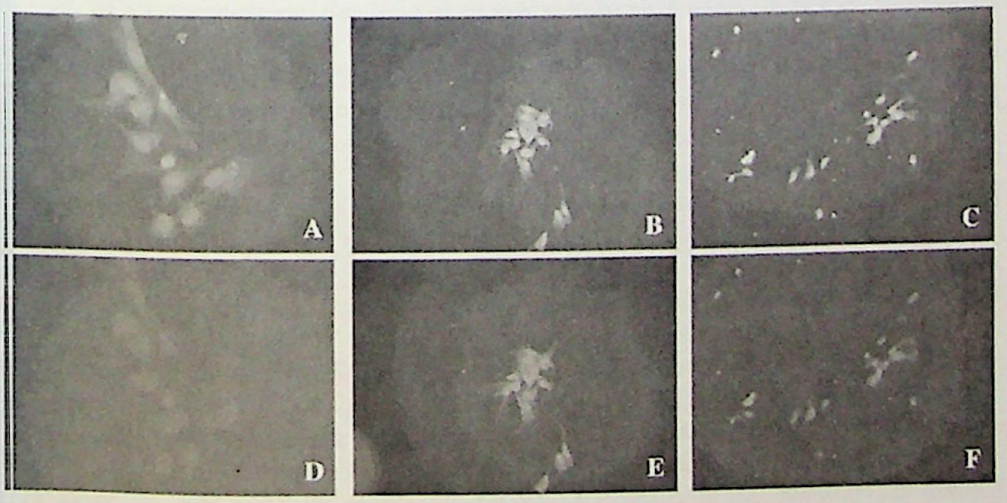

Figure 3: Fluorescent photomicrographs depicting immunoreactivity of RAGE (panels A-C) and of NFκB (panels D-F) in Schwann cells incubated in defined media (panels A & D), in defined media supplemented with 25 mM D-glucose (panels B & E), or in defined media supplemented with 25 mM L-glucose as an osmotic control (panels C & F) for 7 days in culture.

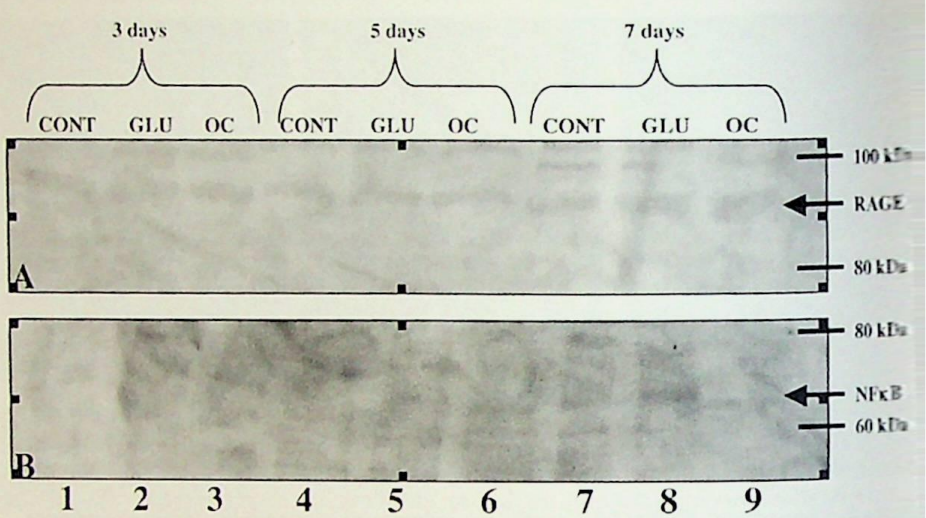

Figure 4: Immunoblot depicting immunoreactive bands for RAGE (panel A) and for NFκB (panel B) present in lysates from Schwann cells incubated in defined media (CONT), in defined media supplemented with 25 mM D-glucose (GLU), or in 25 mM L-glucose to serve as an osmotic control (OC) for 3, 5, or 7 days in culture.

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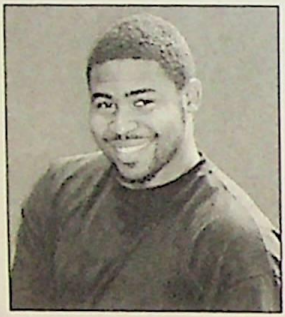
Laser-Tissue Interaction: Raman Spectroscopy



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Abstract

Lasers have become a common, "real world" tool in a wide variety of applications from manufacturing to medicine. The understanding of laser effects in biological systems is crucial to their application. This research presented will summarize, instrumentation constructed and experiments conducted this summer to detect changes in the chemical and structural makeup of cells and tissues from exposure to laser radiation. The experiments include pump-probe experiments with Raman spectroscopy using multiple lasers and with the data collected at sub-cellular precision. A few preliminary results will be presented demonstrating cellular structure due to laser heating.

Introduction

Since the first laser (light amplification by stimulated emission of radiation) construction in 1960 by T. H Maiman, laser research has served as a pioneer in a wide array of applications for the laser from manufacturing products to surgical procedures. Lasers provide a more simple and precise, and non-invasive method of surgery and greatly improve the success rate of surgery. Along with the introduction of lasers into the biological realm we must aim our research efforts to understanding safety, physical effects, and chemical effects on a molecular level when laser radiation of a given wavelength and intensity is introduced. One of the problems in understanding these effects of the cells is the complexity of these biological systems, coupled with the massive number of physical changes triggered by a medium-to-low powered laser makes. It is difficult to pinpoint effects on a molecular level.

A possible solution to this localized problem is to isolate selected areas of the cell in space with real-time variations at a specific point, in which a tightly focused-short pulse laser will be directed. Therefore, the biological effects are more concentrated and

then the effects can be readily identified and analyzed. Firstly one advantage of this type of research is with a tightly focused laser on a specific part, the energy is localized to a single organelle or cell. The total damage of the entire biological system is minimized. This information is vital for both research and the medical industry, that a specified part of a biological system can be altered without affecting the rest of the system. Secondly, by applying shorts bursts of laser radiation to a specific area, we observe the changes in the cell's evolution on a time scale from picoseconds (10−12s) to minutes and hours (104s) [4]. When laser pulses interact with a biological system, they trigger a series of mechanisms that result in chemical and structural changes, We then can visualize by using Raman micro-spectroscopy. Working alongside Vladislav V. Yakovlev from the University of Wisconsin, Milwaukee and the Air Force Research Lab, we will study and analyze these chemical and structural changes due to laser radiation.

Raman Spectroscopy

Spectroscopy is study of the light dispersed from the interaction between radiation and matter; the dispersed light separated into its components across the spectrum of corresponding wavelengths. This is used in optical physics, which allows particles of materials and matter to be identified and mapped based upon the spectra that is produced from the interaction. A more specific technique of using spectroscopy is to determine certain characteristics of matter by using Raman spectroscopy.

Raman spectroscopy observed experimentally in 1928 by Sir Chandrasekhara Vankata Raman (1888-1970)[2], is a technique to study vibrational, rotational effects from scattered light. Raman scattering uses monochromatic light (single color, single wavelength), usually from a laser within the color spectrum from visible to near infrared, and to near ultraviolet range. The laser light interacts with the vibration in a rigid crystal lattice, such as the atomic lattice of a solid, or phonons, or other excitations in the system. The resulting energy of the laser photons being shifted up or down the shift in energy gives information about the characteristic vibrational modes in the system [3].

Typically, a sample is illuminated with a laser beam, and the light from the illuminated spot is then collected with a lens and then sent to a spectrometer. Within the spectrometer with the use of gratings and mirrors, the source light is then split into corresponding wavelengths lines, are then displayed on a spectrograph. One of the issues with this spontaneous scattering is the Raman scattering is typically very weak signal, and mixed with other scattered light from the laser, and difficulty is separating the weak scattered light from the intense Rayleigh scattered laser light. In order for scattering to take place the laser must be a wavelength that is not absorbed by the molecule. Absorption occurs when the source has enough energy to bring the molecule into an exited electronic state. The light resulting from the radiation will be luminescent and complete with Raman signal. [1]

Theory

The Raman Effect occurs when light imposes upon a molecule, interacts with the electron cloud of the bonds of that molecule, and excites one of the electrons or modes of vibration into a virtual state. The type of scattering depends on where the electron relaxes. Our research will focus on Stokes or the lower energy emission. When the molecule is excited from the ground state to a virtual energy state, and relaxes into a vibrational excited state, this generates the Stokes Raman scattering. If the molecules initial state is already in an elevated vibrational energy state, then the scattering is to be considered Anti-Stokes Raman scattering.

Polarizability, or charge distribution in the electron cloud, with respect to the vibrational intensity will determine Raman scattering and the Raman shift will be equal to the vibrational level that is involved, and also defined in following equation, and the energy level translations are also shown in Figure 1.

$$p = \alpha E \qquad (1$$

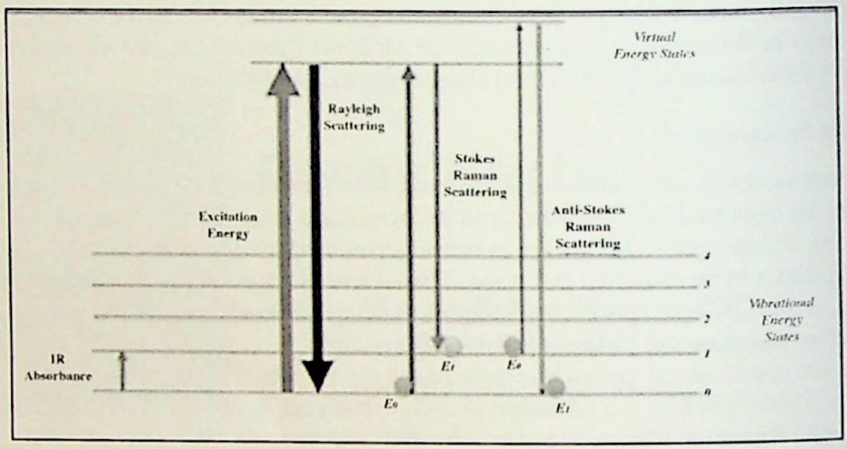

Figure 1: Strokes and Aint-Strokes molecule energy transitions

The polarizability (α), is defined as the ratio of the dipole moment (p) and the atoms to the electric field (E) that produces this dipole moment. Therefore the amount of change in the electric field will result in the intensity of the output scattering. Raman scattering is an important technique used in the realm of spectroscopy, because the amount of scattered light is a direct response to the possible molecular combinations involved in the cell. Therefore cell identifications can be made based upon the type of scattering.

Experimental

Experimental Set-Up

The initial experimental setup used was the combination of two separate laser sources combined at a single point using a Raman microscopic objective to collect the Raman scattering signal. The first laser source a Titanium-Sapphire (800nm – 1150nm) short-pulse laser, naturally generating pulses approximately at 250fs (10−15s), which propagate at (650nm – 1140nm) considered to be a near-infrared. The second laser, is a 532nm continuous wave (CW),used as the focusing laser to excite the Raman spectra from the microscope. The first task once the shutter was open on the Titanium-Sapphire was to get the laser mode-locking with a continuous output power of 4.46W. Mode-locking is a technique used to produce extremely short pulses of light with a fixed phase relationship between the external pulses and laser's cavity to create a temporal shape shown in Figure 2 and also described by the following Gaussian equation:

$$f(x) = a \exp\left(\frac{-(x-b)^2}{2c^2}\right) \quad (2)$$

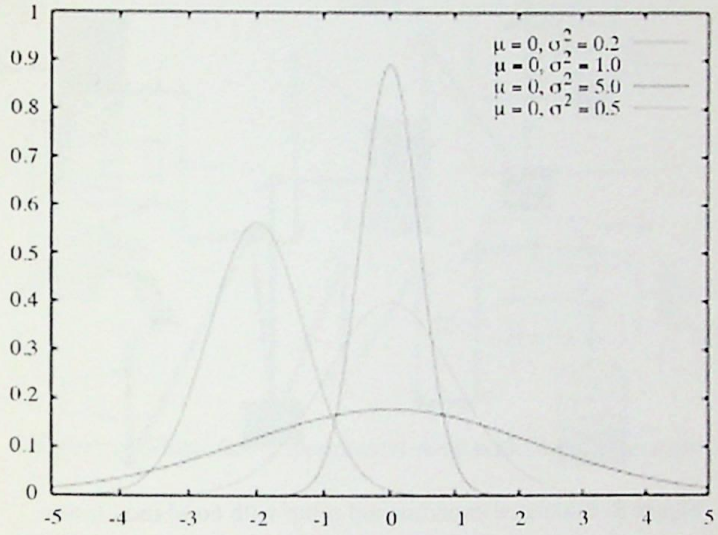

Figure 2: Gaussian Temporal Shape

The lasers bandwidth is able to be seen by using software I00Base 32, which displays the power and wavelength spectrum of the laser in real time. With this information our goal is to get the laser in-phase and pulsing at 10fs (10^{-15} s), instead of 250fs (10^{-15} s), because shorter pulse time then means more peak power is produced. To do this requires that the bandwidth should be increased; the bandwidth and pulses are inversely proportional. Therefore when one increases bandwidth the other decreases pulse time, so to decrease pulse time and increase bandwidth this will produced the Gaussian-shaped pulses. One of difficulties experienced with mode-locking a laser is since laser a pulse disperses as it propagates through glass or reflects off a mirror, the laser pulses begins to chirp. Which is the phase between pulses becomes delayed. To solve this problem of the chirp, is a negative chirp needs to be generated, by introducing in our case a series of bounces, or white cells into the set-up. The laser signal is pre-chirped, or pre-dispersed before the signal passes through certain medium, so as the laser propagates the chirp or delay becomes less, because the signal had previously been pre-chirped before reaching the medium. Our goal of 10fs pulses was not reached, but we were able to achieve pulses of 12fs pulses, and in our case, these short pulses are short enough for our experiment.

The combination of the two laser sources were tightly focused on the cell samples, and combined with a microscopic objective (Mitutoyo, N.A. =0.5). The scattering from the interaction between laser and the cell samples will then be transferred into the spectrometer and the spectral lines will then be captured by the CCD and displayed on the computer. The experimental setup is shown in Figure 3. The second set of experiments will only include the single 532nm laser and analyzing the scattering form this interaction shown in Figure 5.

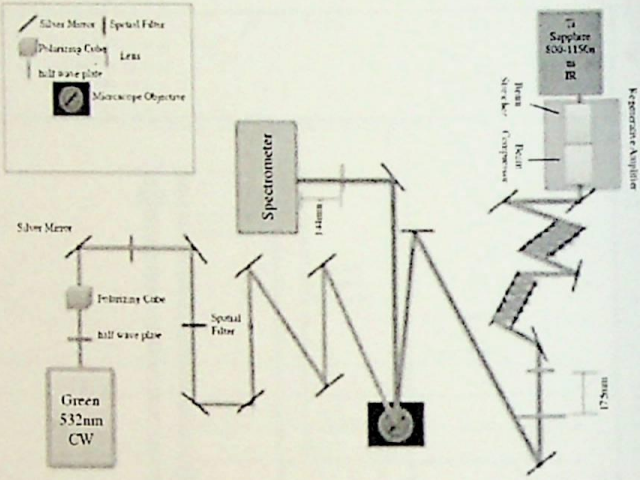

Figure 3: Simulated experimental setup with combined lasers

The types of cells that will be used in these are experiments mineral oil samples, melanin samples, melanosome samples, and RPE cells. The first mineral oil was chosen as a test sample on the grounds that it is inexpensive, similar to fat lipids, transparent, nearly impossible to damage, from light, and the scattering signal is strong. The melanin samples were also chosen along the same grounds. Moreover, it was selected because melanin is found in the human hair and human hair is easily collected. Also, for preliminary tests, the melanin in the hair sample provides a sample test to the possible effects to the melanin containing cells. The melanosome sample provides a more complicated organelle for testing. The complexity of the melanosome samples shown in Figure 8, and the availability of melanin samples the result is the RPE cells. RPE cells are Retinal Pigmented Epithelium shown in a cross section of the eye in Figure 9, are tissues found behind the retina in the eye which act as backstop for the light. When too much light is absorbed into these tissues, retinal damage can occur.

These melasomes samples and RPE cells will be placed on the pico-motor which is under the microscopic objective and the single 532nm laser tightly focused on selected parts. Based upon a specified exposure time the data acquisition will begin and the selected area of ± 20μm × 20μm scanned. Each scan point will be ±3μm in distance from each other. Once the data is collected it will be analyzed and the difference between the Raman scattering and the background light will be calculated. These sample cells are being scanned because they are more complex and scanning these organelles will result in the chemical and structural from the inner portions of the cell and the outer membrane the outer cell.

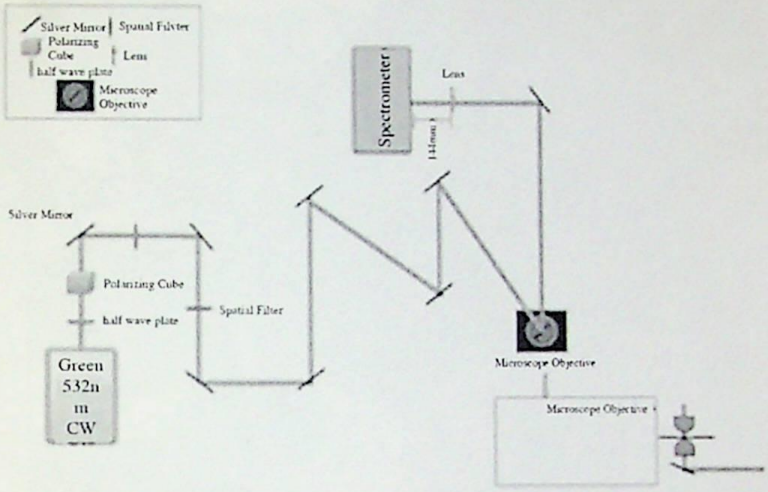

Figure 4: Simulated experimental setup with single laser source

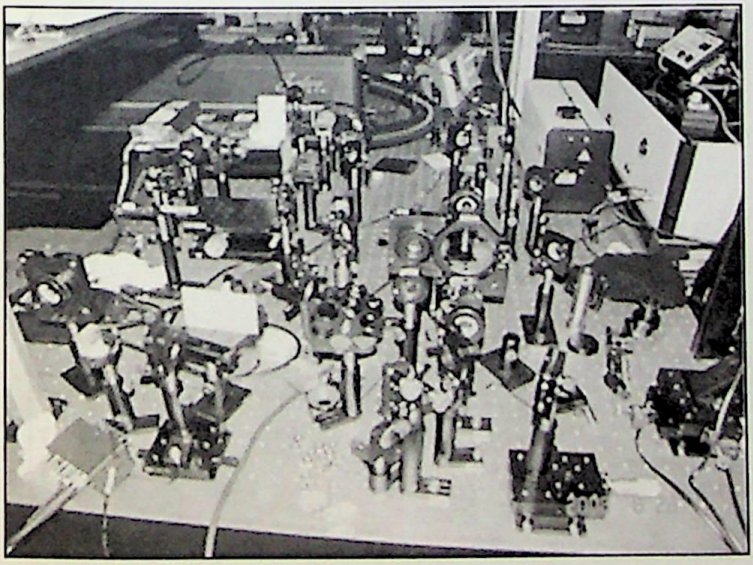

Figure 5: Experimental setup front view with the 532 -nm laser at the back left corner of the frame

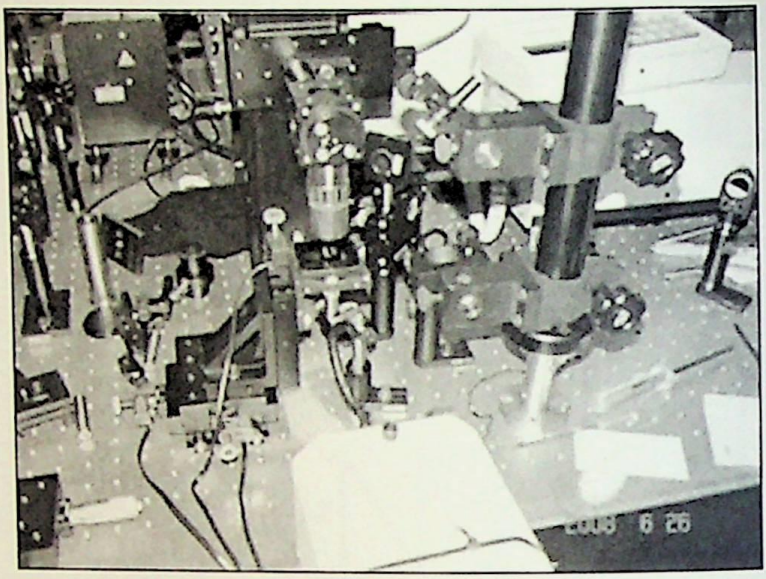

Figure 6: Experimental setup side view with optic

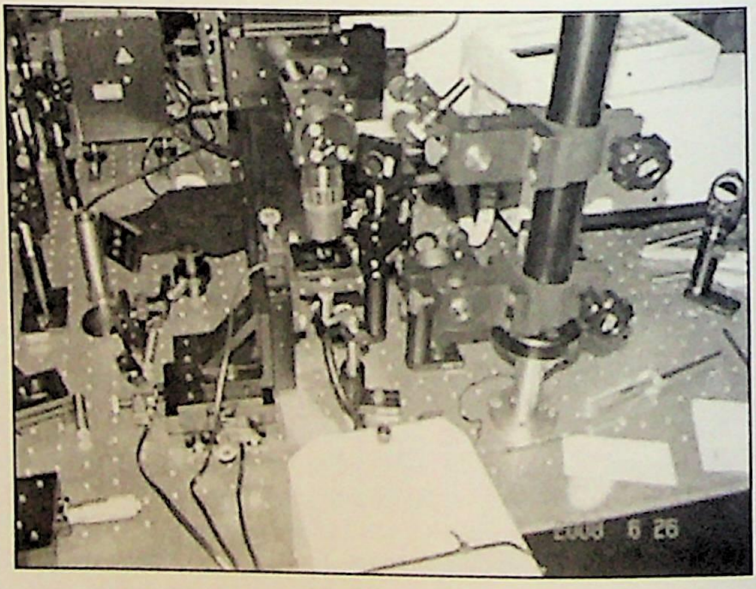

Figure 7: Experimental setup showing focusing microscope

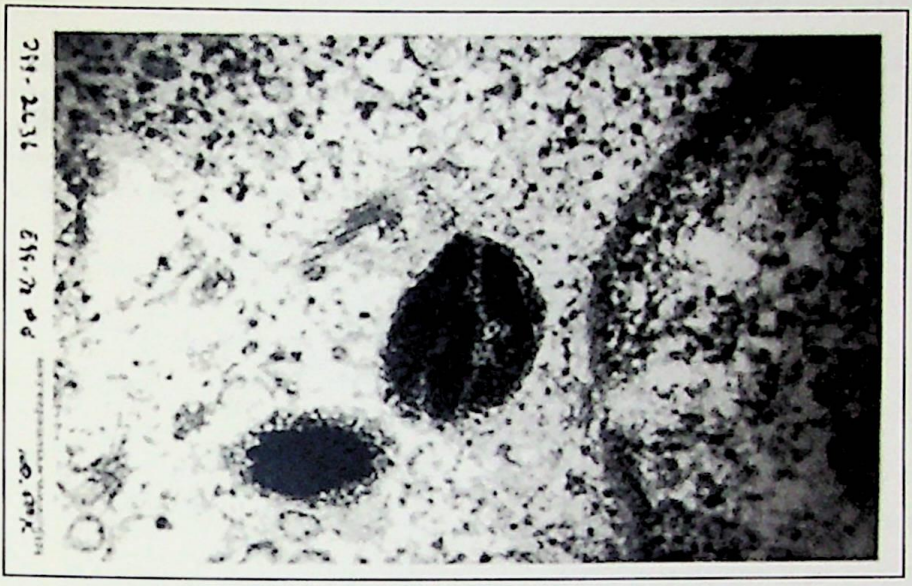

Figure 8: Stage IV Melanosomes with cytoplasm

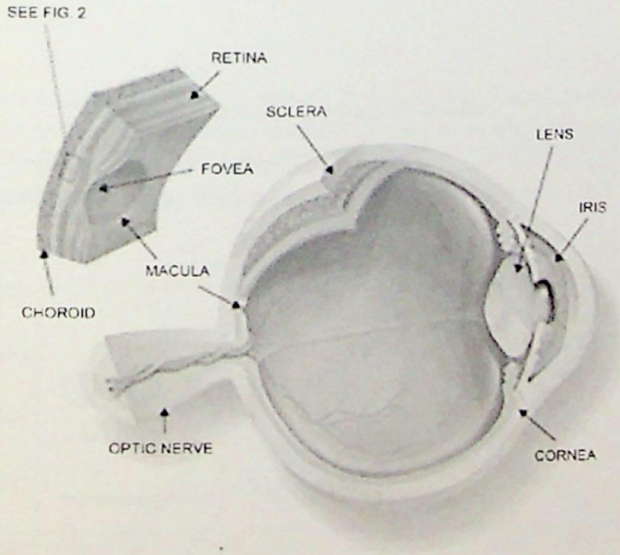

Figure 9: Cross section of the eye showing RPE tissues

Experimental Results

The results shown below are generated from the collected spectrum, and then the wavelength is converted into corresponding wave-number by the following equation:

$$conversion\ factor = \frac{1}{\lambda} = cm^{-1}$$

$$wavenumber = \frac{1}{\lambda_{laser}} - \frac{1}{\lambda_{emission}} = \Omega\ (cm^{-1})$$

Mineral Oil

After a set of multiple tests with the exposure time of 100s each, the data collected from the spectrum was generated and is shown in Figure 10. We concluded that the Raman scattering generated an intensity peak at wave-number 2900cm^{-1}. Therefore mineral oil exhibits the expected Carbon and Hydrogen, (CH) combination, and also has the presence of Rayleigh scattering. This part of the experiment is to insure that are test were accurate and the data we are collecting from the spectrograph is precise.

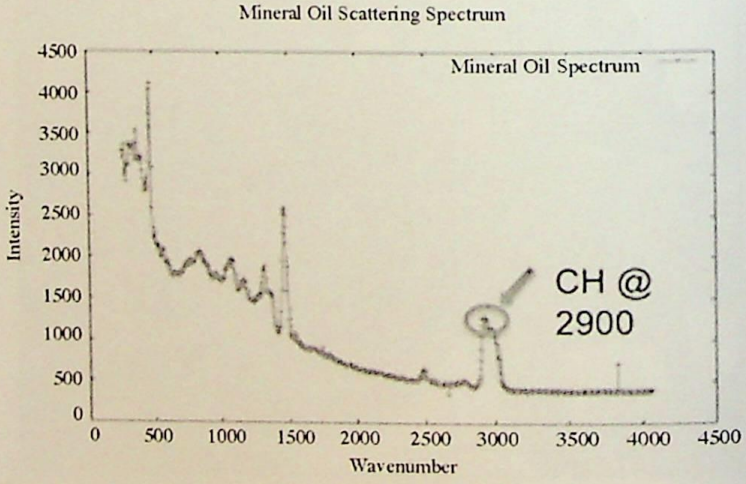

Figure 10: Mineral oil Raman scattering spectrum containing molecular combination of CH

Melanin

The melanin samples received an initial scan area of 20μm × 20μm, with an output power of 3mW at 532nm. Each exposure time was 100s, and after a total of 3000s the spectrum was collected and spectrum from *t = 0s* to *t = 3000s* are shown in Figure 11. The spectrum displays that after the 3000s the melanin cells were either damaged, or they began to absorb the light source, because there is a significant drop in the spectrum.

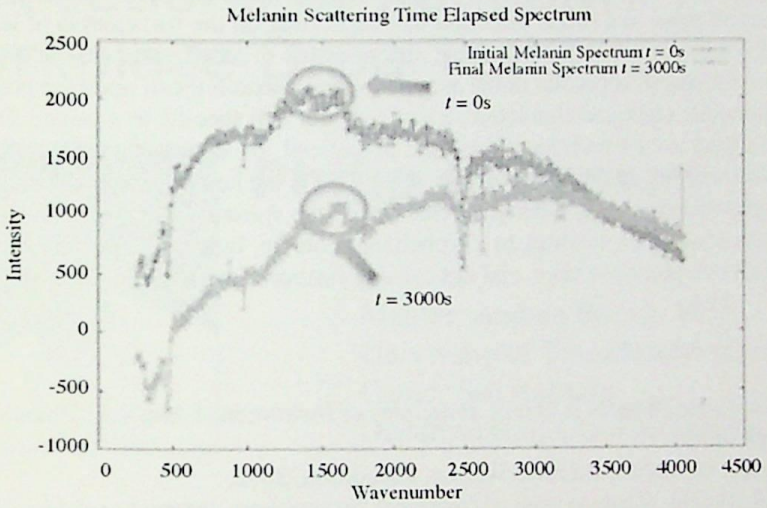

Figure 11: Melanin Raman scattering spectra measured before and after 3000-s exposure

Melanosomes

Melanosome spectrum collected, shown in Figure 12, demonstrates that after the 3000s scan time there is a significant amount of change in the spectrum around wave-number 1500. The amount of change in the two spectra can be defined by the difference in slope from each other at the region of interest ± wave-number 1500.

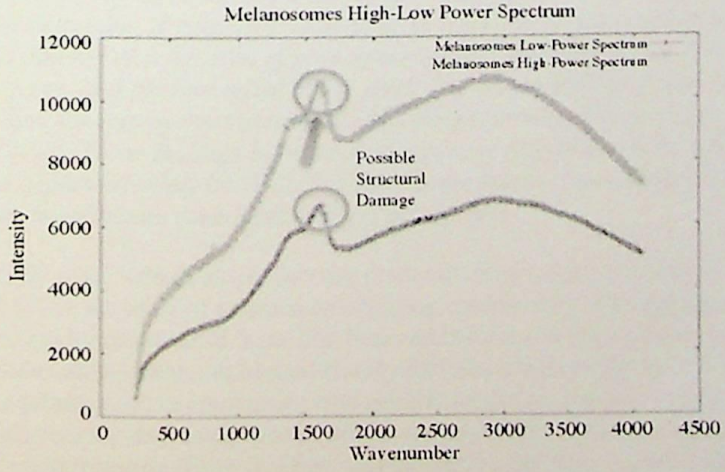

Figure 12: Melanosomes Raman scattering profiles illustrating possible damage after increase in power

RPE Cells

The results of the RPE cells are pending and the data collection will continue past the conclusion of this paper.

Conclusion

Based upon the data collected from each experiment, the mineral oil, melanin, and melanosomes all point to a single direction that depending on the wavelength of laser one could possibly pin-point a certain chemical characteristic of a cell, target it and eliminate it. This type of research is pivotal in the area of cancer research it can open the possibility to determine the chemical characteristics of a cancer cell specific to a person. By introducing a laser with a wavelength specific to that cell, we then can possibly eliminate the cancer cell without damaging any other cells. This is the key to medical success to fix a problem without causing other problems within the system. Therefore, this type of research gives a localized solution, to a globalized problem, by acting upon each specific part of the cell one point at a time, and not causing further damage to the total system.

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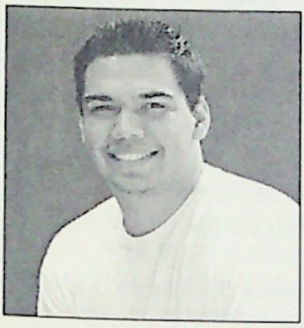
[5] www.amdcanada.com Cross Section of the Eye containing RPE Cells.

Factors Influencing Employee Perceptions of Random Workplace Drug Tests



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Abstract

From 1996 to 2004, the percentage of employers implementing drug testing programs in the United States dropped from 81% to 62%. Although past research has shown that eliminating drug users from the workplace can save employers money, the trend in declining drug testing programs suggests that the benefits of drug tests may not outweigh their cost. The current study examined factors that influence an employee's likelihood to work for employers that require random drug and alcohol tests. Participants (N = 24, 352) who worked in full-or-part-time jobs and were between the ages of 18-64 were selected from the National Survey on Drug Use and Health (2006). X2 analyses and ANOVAs were performed to determine if employee likelihood to work for employers that require random drug tests differed as a function of participant' gender, work status (i.e., full- vs part-time), total drug use, and psychological stress level. The results indicated that employee likelihood to work for employers requiring random drug tests varied by each factor, particularly by stress level. These findings indicate that employee negativity about random drug tests cannot be explained solely by their drug use. Future research should examine the degree to which non-drug factors contribute to these perceptions.

Currently over 50% of employers are randomly drug testing their employees (Holding, 2006). The majority of companies requiring random drug test base their programs on federal guidelines desired from The National Institute on Drug Abuse (NIDA, 2008) and the Substance Abuse and Mental Health Services Administration (SAMHSA, 2008). These guidelines require companies who employ commercial class drivers to drug test their employees for five categories of drugs: cannabinoids, cocaine, amphetamines, opiates, and phencyclidine (Erowid, Drug Testing Basics, Section 1, 2008). Many companies administer an extended drug test that can detect the presence of additional drug classes. There are five primary types of employee drug tests administered by employers: urine,

blood, hair, saliva, and sweat of these five the most common drug test is a urine test due to its low cost and ease of administration (Erowid, Drug Testing Basics, Section 3, 2005). A 2006 survey by the Society for Human Resource Management found that 84% of employers require new employees to pass drug screenings, and 39% continue to randomly test employees after hiring. In addition, 73% of employers tested employees when drug use was suspected and 58% required testing after employees experienced accidents in the workplace (White, 2007). The drug testing industry results in cost of about $1.5 billion annually, so understandably there is much controversy regarding the cost benefit ratio of drug tests in the workplace.

In 1999, an ACLU study found the federal government spent $11.7 million to find 153 drug users among 29,000 employees (Holding, 2006). The study suggested the total costs of drug testing may outweigh their benefits when the ratio of positive tests to total employees is so low. In addition employers may not only be spending money inefficiently but also failing to attract potential job applicants. Spokesman, Bruce Mirken of the Marijuana Policy Project in Washington D.C. stated

> "According to government surveys close to 15 million Americans use marijuana at least monthly and somewhere close to 100 million have tried it, and that collection includes the last two presidents of the United States, the mayor of New York City. ... Would you really want to screen those people from your applicant pool?" (White, 2007).

Past research supports Mirken's statement as research also indicates that employees who use drugs or have used drugs tend to perceive drug tests more negatively than non-drug users.

A study examining college students' attitudes toward several aspects of drug testing programs found a correlation between frequency of drug use and acceptability of employee drug testing. The research sample was composed of undergraduate students (N=181) who participated to satisfy a class requirement. The students were asked to report the degree to which they agreed with the use of workplace drug testing programs as a function of job types, reasons for drug testing, drug test types, and consequences based on positive drug screens. The students were also asked to report how frequently they used drugs on a 4 and 5-point scale (1=none, 4=frequently or 1= never, 5=daily). Frequency of drug use was found to be significantly correlated to overall approval of drug testing; specifically increased frequency of drug use resulted in significantly lower approval (Murphy, et al., 1990).

Another study (Truxillo, et al., 2002) used organizational justice theory to examine reactions to employer drug alcohol testing and treatment policies and found similar results. In this study participants answered telephone interview questions as part of a statewide drug and alcohol prevalence survey. Participants were selected using Random Digit Dialing sampling. The sub-sample (n= 1777) only included participants who worked full time, part time, or were on leave from their jobs. The study revealed higher levels of alcohol use correlated with lower levels of perceived fairness regarding the use of alcohol tests in the workplace.

Another study using the similar methodology found similar findings which support the relationship between drug use history and perceived fairness regarding the use drug test. Participants were only selected if they had familiarity with employer drug tests through present or past employers and were surveyed by telephone. The survey included general demographics, drug use history, drug test program fairness, and drug test consequences. Approximately 20% (n= 31) of participants were categorized as using, 40% (n= 96) were categorized as prior drug users, and the remainder 40% (n= 96) had never used drugs. The results revealed that participants who had never used drugs perceived drug tests as

more fair than non-drug or those with prior drug use. The study also found participants reacted more positively to drug test programs providing rehabilitation vs. programs that automatically terminated their employees following a positive drug screen (Truxillo, et al., 2001).

Another study examined potential job applicants' reactions to drug testing also supported the previous research. Participants were undergraduate (junior and senior) business students recruited from a public university (N= 128). Participants were asked to put themselves in the role of a recent college graduate searching for a job. Each participant was given hypothetical scenarios of one company and different drug testing consequences (i.e., to rehabilitate or terminate employees based on a positive drug screen). The study also investigated whether participants' attitudes differed as a function of drug use and attitudes toward drug use. No differences were noted in perceptions of employer use of drug tests as a function of the consequences of a positive drug screen. However, perceptions about employer drug tests showed significant differences as a function of prior drug use and attitudes about drugs. Specifically participants were more negative about drug tests if they reported prior drug use or had positive attitudes about drug use.

Many employees may also be reluctant about working for an employer that drug test due to the resentment of an invasion of privacy (Holding, 2006). The American Civil Liberties Union describes drug testing as intrusive, degrading, and an invasion of privacy (ACLU, Workplace rights – Drug Testing, 1997). When being drug tested employees are often watched as they urinate as to eliminate specimen tampering. This experience may be perceived as humiliating to many employees as well as a direct invasion of privacy. There is also a possibility that human error in lab results could lead to false positives. Drug tests do not measure if drug use results in job impairment. Rather, they test for the presence of drugs within a person's nervous system, and indicate whether that person has recently used drugs or shows traces of drug use in the recent past. The ACLU also proposes that employer drug testing is intrusive because employees' use of drugs may or may not occur in the workplace.

Considering the perspective of the American Civil Liberties Union, the present study seeks to understand if factors other than drug use influence employees' perceptions of random workplace drug tests. Previous research has primarily focused on current and past drug use as the main contributor of negativity towards random drug tests. The present study also incorporates gender, work status (i.e, full vs. part-time), and psychological stress level as factors that may influence employees' likelihood to work for employers that randomly drug/alcohol test. The present study hypothesized that participants who indicated they were less likely to work for employers that randomly drug test would be more likely to be male, currently work part-time, report prior drug use, and report higher levels of psychological distress.

Method

Participants

A total of 24,352 participants were sub-sampled from the National Survey on Drug Use and Health (2006, N= 55,279). The National Survey on Drug Use and Health (NSDU) is administered by RTI international and sponsored by the Office of Applied Studies within the Substance Abuse and Mental Health Services Administration. The NSDU has been conducted since 1971 and provides information about the use of illicit drugs, alcohol, and tobacco among the non institutionalized U.S civilian population aged 12 or older. For the current measure, a sub-sample was selected if they worked full or part-time and were between the ages of 18-64. The final sample (N= 24,352) was composed primarily of employees working full-time (77%) and was almost evenly distributed

by gender (male = 51%; female = 49%). Race was not included in the experiment as a factor. Over 64% of the sample was Caucasian of seven different categories of ethnicities. Almost 60% of the final sample reported prior drug use and an average severe psychological distress (SPD) score 5.92 (SD = 5.62).

Procedure

Participants reported whether they would be more likely, it made no difference, or less likely to work for an employer that randomly tested employees for drug or alcohol use. The data was recoded so that participants responding as "less likely" received a lower score than those who were "more likely" (less likely = 1, more likely = 3). A new variable was created in the data to indicate whether employees had ever used drugs (No = 0, Yes = 1). This variable was created first by summarizing the total number of "yes" responses to prior use of marijuana/hashish, cocaine, crack, methamphetamines, and other stimulants. This procedure resulted in a score ranging from 0 (no drug use) to 6 (use of alcohol or drugs). The prior drug use variable was then derived by recoding total scores of "0" as non-drug users and categorizing scores of 1-6 as prior drug users. Participants also reported gender, work status, and levels of stress. To determine stress levels, SPD was determined using the K6 screening instrument for nonspecific psychological distress. The six items of K6 indicate how often the participant experienced symptoms of psychological distress in the past year when they felt at their emotional worst. The items addressed how often the participant felt nervous, hopeless, fidgety, depressed to the point nothing could cheer them up, that as everything was an effort, and worthless. Participants were classified as having severe psychological distress if their score was above a 13 on a 0-24 scale.

Results

To compare the distribution of employee likelihood to work for an employer that randomly drug/alcohol testing by gender and work status, a series of chi square analyses were performed. As expected males were proportionally less likely to work for an employer requiring random drug/alcohol test (n =1259, 10%) but were also proportionally more likely (n = 4494, 36%) relative to females (n = 960, 8%, n = 3953, 33%), $\chi 2$ (2, N = 24352) = 84.09, $p < .01$. When employee likelihood to work for an employer requiring random drug testing was compared to work status, results revealed that part time employees were proportionally less likely to work for an employer using random drug tests (n = 595, 11%) than were full time employees (n = 1624, 9%), $\chi 2$ (2, N = 24352) = 128.35, $p < .01$. To examine if employee stress scores differed as a function of drug use and likelihood to work for an employer requiring random test, a two-way analysis of variance (ANOVA) was performed. The result revealed SPD scores differed as a function of drug use and likelihood to work for an employer requiring random tests, F (5, 24346) = 50.81, $p < .01$. That is, although participants with prior drug use had significantly higher stress scores than those without drug use; participants with higher levels of stress were also proportionally less likely to work for employers that require random drug tests, irrespective of drug use.

Discussion

The present study supported past research on the history of drug use as a predictor of negative attitudes toward drug testing in the workplace and also found new factors that contribute to significant differences in the distribution of employees' likelihood to work for employers requiring random drug test. These factors included gender, work status, prior drug use, and stress levels. Results from Chi square analysis performed on gender

suggest that males are more opinionated in terms of their likelihood to work for employers requiring random drug test. Males were both more likely and less likely to work for these employers whereas females were more likely to be neutral in their likelihood to work for an employer that either may or may not drug test. Results revealing part time employees as less likely to work for employers requiring random drug test suggest part time employees may have higher levels of drug use or less of a concern for workplace policies. Interestingly, significant levels greatly varied when we compared likelihood and drug use to stress levels. As expected we found drug use correlated with higher stress levels, but we also found that higher stress levels alone, completely independent of drug use also decreased likelihood of working for employers that require random drug test. The findings suggest drug tests are not only discouraging drug users from applying to employers with drug testing programs but also non users. These non users may be people who have tried drugs in their past, people who have higher levels of stress, or individuals with greater concern for privacy issues. The benefits of this research support that employers are losing both money and potential job applicants when they require drug tests.

Limitations/ Future Research

The current study only examined overall drug use and did not consider current versus past drug use. The study excluded pharmaceutical drug use as well as a range of various illegal drugs and was non specific in regards to what stimulants were used by participants. Future research considering this variable may reveal current drug use as a significant function of employee likelihood to work for an employer requiring random drug test. More relevant to this study, considering this variable may reveal employees with past experience and no current drug use as also likely to avoid drug tests. To continue research supporting the concern of the benefit to cost ratio, a study examining the ease of manipulating drug test results may reveal further insight. Future research may also want to consider where employee stress derives from and what employee motives are in using drugs. The study may want to consider if the majority of employee stress is originating from work itself or outside factors and if motives for the use of drugs include relief of stress. A composite study of different employers and their cost in drug testing programs vs. employees found using drugs may reveal further insight in the issue of benefits and cost. Finally, a study examining employer motives for not requiring drug tests to employee performance could be of benefit in determining differences in performance between companies that require drug test as opposed to those that do not.

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From Gasoline to Liquid Nitrogen: For the Technically Inclined and Interested

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Abstract

We propose to convert a gasoline powered vehicle into one which runs solely on liquid nitrogen. Such a Zero Emissions Vehicle offers many benefits. Since the source of liquid nitrogen is air (78% of air is composed of nitrogen), it is readily available at a low cost. Expensive and environmentally hazardous battery technology would not be required, and fill up times would take a matter of minutes. One of the most alluring benefits of the widespread use of such a vehicle is the fact that as liquid nitrogen is manufactured, some amount of airborne pollutants are removed from the air. This could include the capturing and sequestering of greenhouse gases such as CO2 and other gases directly linked to climate change and global warming. To do this, the vehicle engine must be stripped of all components that deal with ignition, injection, and exhaust. An automatic valve system will then be developed and installed to control the flow of nitrogen. The gas produced by boiling liquid nitrogen will be fed to the head of the engine making the piston move, which then moves the car.
The project will consist of three phases. Phase I will include all background information, calculations, and a comparison to other fuel sources. Phase II will have all prototypes and bench testing. Finally Phase III will consist of placing the developed liquid nitrogen engine back into the vehicle and road testing. This summer's research for the McNair program concerns the findings of only Phase I and Phase II.

Introduction - Phase I

There are approximately 247 million vehicles in the U.S. today and approximately 97% of those vehicles are gasoline or diesel powered.[1] The current average fuel efficiency of automobiles in the U.S. is 20.2 miles per gallon,[2] nearly 50% lower than on road fuel economy in other industrialized nations.[3] This presents a twofold challenge. First, fossil

fuel supplies are limited. Some estimates indicate that the world could see a peak in its total oil production mandated by resource availability and economic and political factors as soon as 2012.[4] After such a peak, fossil fuel production will decrease. Second, gasoline powered vehicles are extremely dirty. Burning one gallon of gasoline emits 19.4 pounds of carbon dioxide along with a host of other pollutants.[5] In response to this obvious need for a shift away from fossil fuel powered vehicles, we propose to explore the use of liquid nitrogen as a combustion-free, clean alternative vehicle fuel.

The power for a vehicle running solely on liquid nitrogen would come from an engine that uses a substance at sub-atmospheric temperature (liquid nitrogen) as a heat sink and the atmosphere as a heat source. Such an engine has been called a cryogenic heat engine[6] A cryogenic heat engine works on much the same principles as an open cycle steam engine. In a steam engine, fuel is burned to provide the heat needed to cause water to undergo a phase change from a liquid to a gas. Further heating of the gas results in compressed gas (compressed water vapor) that runs an expander. Exhaust gas is then released into the atmosphere. In a cryogenic heat engine, ambient heat from the atmosphere is used as a heat source to cause liquid nitrogen to undergo a phase change from a liquid to a gas. Subsequent heating of the gas, provides rapid expansion to run an expander. The exhaust gas, nitrogen gas, is released into the atmosphere. It should be noted that air is composed of 78% nitrogen, and so the exhaust gas of a liquid nitrogen engine is simply the most prevalent naturally occurring component of air. A cryogenic heat engine running on liquid nitrogen is an environmentally clean, combustion-free engine which could be used for Zero Emission Vehicles.

A liquid nitrogen vehicle has no tailpipe emissions. It does, however, take energy to make liquid nitrogen. Many large-scale air separation plants are already in place to fill the widespread industry demand for nitrogen. Such plants process several millions of cubic feet of air per hour. The electricity to run such plants comes from grid electric power. While approximately 70% of the grid electric power in the U.S. is produced by coal, petroleum and natural gas, approximately 30% of it is produced by hydroelectric, nuclear and other renewable sources from which there are no greenhouse gas emissions. The "emissions" then from a liquid nitrogen automobile do not come from the tailpipe of the vehicle but rather from the electricity used by the air separation plant. Since the vehicles' emission rates are therefore determined exclusively by the power grid, the environmental friendliness of the vehicles will improve steadily as emission reduction advances are made in grid power production.

Such arguments can, of course, also be made for battery electric vehicles. However, a liquid nitrogen vehicle has further advantages even over these vehicles. Compared to battery technologies, a liquid nitrogen automobile would not involve an expensive battery manufacturing process nor an expensive replacement cost after the lifetime of the battery. In fact, since the source of liquid nitrogen is air (78% of air is nitrogen) and large scale air separation plants like many power plant, are already in place, liquid nitrogen is readily available at a low cost. Also, a liquid nitrogen vehicle involves no environmental hazards from the use of heavy metals unlike lead-acid or Nickel-Cadmium batteries. Fill up times for a liquid nitrogen vehicle would be a matter of minutes, compared to hours for recharging an electric vehicle.

There are certain basic emissions and energy advantages inherent to a liquid nitrogen powered vehicle as well. As an industry-wide rule of thumb, it takes 0.6 kW-hr to produce one kilogram of liquid nitrogen.[7] Figure 1 compares the carbon dioxide emissions from a gasoline powered vehicle (tailpipe emissions) with the emissions from a liquid nitrogen vehicle (emissions from grid electric power). In terms of carbon dioxide emissions, a liquid nitrogen powered car with a fuel efficiency of 1 mile per gallon (of liquid

nitrogen) is equivalent to a 20 mile per gallon gasoline powered car. A 3 mile per gallon liquid nitrogen car is equivalent to a 58 mile per gallon gasoline vehicle, and a 5 mile per gallon liquid nitrogen car is equivalent to a 97 mile per gallon gasoline vehicle. Figure 2 shows a comparison of the raw energy required to run various vehicles. A 5 mile per gallon liquid nitrogen car's energy requirements are less than half that of a 50 mile per gallon gasoline car or that of a hydrogen powered vehicle. They are equivalent to the energy requirements of the most sophisticated electric powered vehicles.

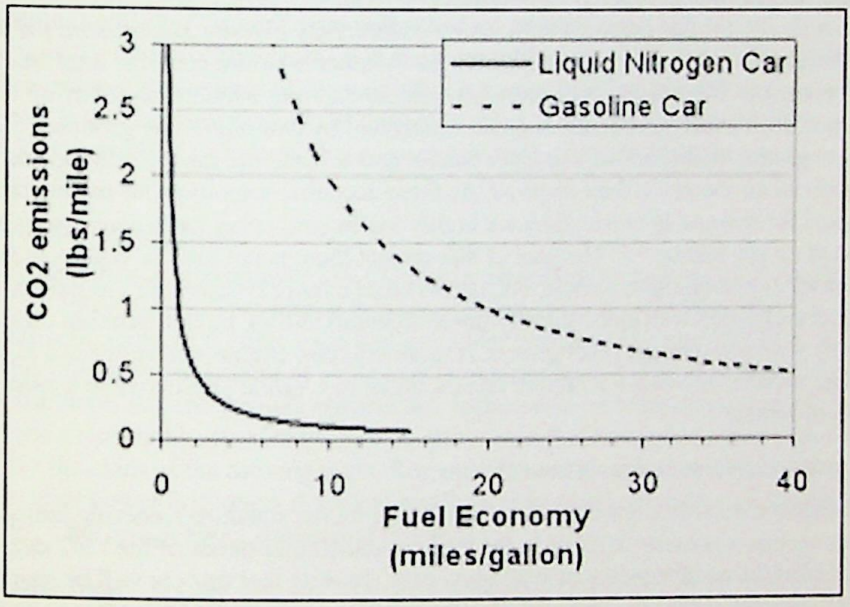


Figure 1: Carbon Dioxide emissions from a liquid nitrogen powered car (solid line) compared to that from a gasoline powered car (dashed line.)

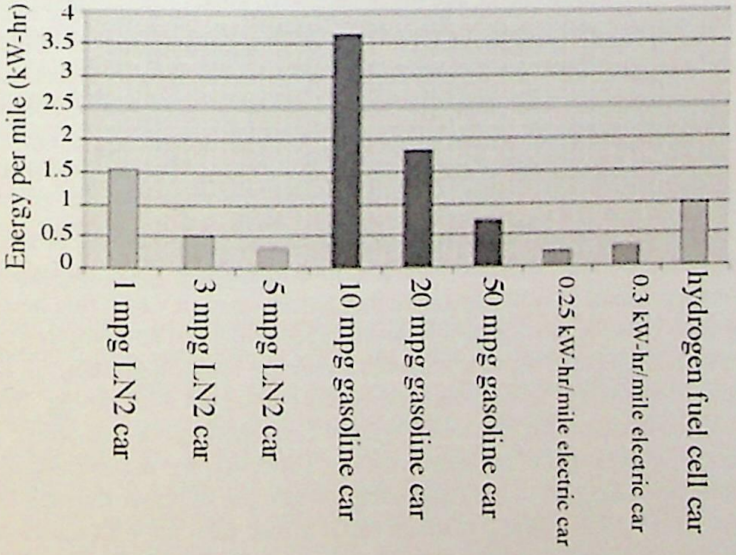


Figure 2: Comparison of the energy requirements for vehicles powered by liquid nitrogen (LN2), gasoline, electric batteries and hydrogen fuel cells.

Finally, one of the most enticing benefits of using liquid nitrogen as a vehicle fuel is the fact that as liquid nitrogen is manufactured from air, some amount of airborne pollutants are necessarily removed. Carbon dioxide could also be separated in the liquefaction process and then sequestered through various means that would not contribute to greenhouse gas emissions. In the long term, if renewable energy sources alone were used to produce liquid nitrogen, then in a very real sense, the more liquid nitrogen engines were used, the cleaner our air would become. With the ever growing concern over climate change, this advantage is not to be overlooked.

Specifically for this project, the St. Mary's University Physics Department purchased a Club Car Carryall 1 utility cart with a single-cylinder 4-stroke gasoline internal combustion engine. We propose to convert this vehicle into one which runs solely on liquid nitrogen. Such a feat has already been accomplished by two university groups.[8-10] Each of these groups built proof-of-concept vehicles and so used the most readily available commercial air motors at their disposal. As these eccentric vane-type air motors are not designed for this use, however, they are highly inefficient, using large amounts (≈7000 liters) of air per minute.[11, 12] The goal of this project then, is not only to build a proof-of-concept liquid nitrogen vehicle, but also to build a more efficient air engine using a cylinder and piston with electronically timed solenoid valves, thus improving on the fuel efficiency achieved by the other groups. A more efficient engine will result in a higher mileage vehicle, one which therefore comes closer to a viable alternative to a gasoline powered vehicle.

Pragmatics of Conversion - Phase II

Reference is made to gasoline engines running on the standard Kettering ignition system so that it is easier to relate to the various and similar needs of the LN2 engine. This makes the understanding of it all quite easy. To state that this car will be running on Liquid Nitrogen (LN2) is somewhat of a misnomer. In reality, the liquid begins to boil at somewhere around -324° F, and in a closed containment chamber gas pressure begins to build. Other considerations such as pressure relief valves and heat exchangers must also be dealt with as the design progresses.

It was on August 18, 2006 that the question was posed: "Can a gasoline engine be converted to run on Liquid Nitrogen (LN2)?" The short simple answer is "Sure!" However, as in most projects, there are several problems that creep into a project early on demanding recognition and resolution. The basic concept of this proposed conversion is quite simple. Running on gasoline, the single cylinder, four stroke engine converts chemical energy into mechanical energy through the agency of heat. That is why they are called "heat engines."

The cylinder head, along with the overhead valves and pushrods will be removed, and a new cylinder head will be machined from half inch aluminum plate, probably out of 6061-T6, a good grade of aircraft aluminum that machines well. Onto this head will be attached a suitable solenoid valve (possibly several) controlled by an optointerrupter single slot encoder that will replace the now removed Kettering ignition system. An incremental BEI encoder may be used to solve several problems connected with timing. Instead of the four stroke engine it used to be, it is now instantly converted into a two stroke engine that still operates on the principal of expanding gasses. However, the pressurized gas is now produced from the boiling off of LN2 and admitted into the cylinder through the solenoid valves where before it was burning gasoline vapor mixed with air with a fuel-air ratio of 1:15 and producing this pressurized gas by combustion. On liquid nitrogen the power impulses are once each revolution of the crankshaft instead of every other revolution when it was a four-stroke like your car engine. Either way, the engine still runs on expanding

pressurized gas and does not know the difference. It does not care where the pressurized gas comes from, only that it gets there at the right time each revolution. In truth, the engine will not be running on Liquid Nitrogen but on the gas produced by the boiling off of the LN2 at atmospheric temperatures.

The far reaching advantages are several with the most prominent one being no unburned hydro-carbon emissions expelled to the atmosphere we breathe. Economy is another aspect. The calculations have determined that if the fuel economy of this machine can equal approximately 3 miles per gallon (MPG), then we are at the break-even point, and in "miles per dollar" we are even with standard gasoline cars.

And now the first problem rears up in the form of the solenoid valve. To be explicit, it is the flow volume throughput of the valve that becomes problem number one, and right on its heels is the response time (2) of this same valve. Then comes the need for variable timing (3) and dwell (4). Once all these issues are dealt with satisfactorily, you have a viable product.

1. The volume throughput:

This engine has approximately 290 CC displacement (swept volume) or approximatly17.69 cubic inches. This means that ideally each down stroke of the piston is caused by the influx of some 17.6 cubic inches of gas under pressure. At a target RPM of 3000, it means this process would occur at a rate of 50 times per second. The valve must be able to pass that much volume through without any appreciable pressure drop across the ports. This means a reasonably sized valve, which also means that its response time is slower because of the mass of the moving parts. Response time is the time required to fully open the valve after power is applied. A typical small valve has a response time of 10 ms (milliseconds). This brings about the second problem.

2. Response time:

At 3000 RPM the time from top dead center to bottom dead center (BDC) is 10 ms. However, that is the exact response time of the valve which means if you were to command the valve to open to fill the cylinder at top dead center (TDC), the valve would be fully open by bottom dead center 10 ms later. By that time, the power stroke is over. A faster valve could be sought out. Larger valves are not faster, they are slower because of added mass, so maybe multiple valves of a smaller size are a viable approach. It is a matter of determining the flow throughput required and hence the number of valves required. The research is in determining flow throughput in a given valve along with the attending pressure drop, and ultimately determining how many valves are needed to provide the required flow throughput per stroke. There is still this matter of response time which brings us to the third problem.

3. Timing (Advance and Retard):

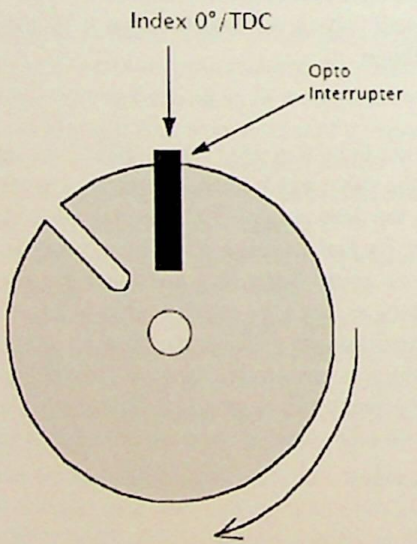
Any engine running on gasoline and the standard Kettering ignition system will have the ignition timing advanced to where the spark occurs approximately 28° before top dead center. This starts the combustion process early enough so that by the time the piston has just started its down stroke, the pressure build up is nearing its peak for maximum power delivery. As the engine varies in speed, the timing is adjusted automatically, and timing is also a function of load and manifold vacuum. The greater the RPM, the more the timing is advanced. Conversely, as RPM decreases, the timing is retarded. Dwell, the time that the points (or electronic switch, a hexfet) are closed, remains fixed throughout the RPM range. It is the amount of time the ignition coil (an auto-transformer) is saturated, and when the points are opened, the field collapses and the spark occurs. In

the LN2 car, the timing is needed to be the same as in the Kettering ignition engine. This means a system must be created to time the firing of the solenoid valves so that the engine will run smoothly; this brings up the forth problem.

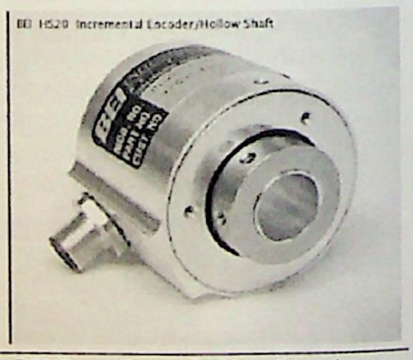
4. Dwell (Saturation):

The power stroke from TDC to BDC varies in time with RPM. As the RPM increases, the power stroke time decreases. Dwell then, is the time the solenoid valve remains open during this amount of piston travel. If the dwell is too short, maximum power will not be developed because the full stroke will not be utilized. If the dwell is too long, gas will still be admitted during the piston up-stroke, slowing the engine down and defeating the entire purpose. It is therefore obvious that dwell must be a direct function of RPM as is timing in #3 above. Consideration for valve response time and RPM dictate the valve "firing" timing so that the valve will be near fully open by the time the crank passes TDC and the piston begins its down stroke. The end of the stroke must be known also, so that the valve can be closed shortly before BDC. Both of these timing needs bring to the forefront discernment between encoder styles. To define and design the specifics of these parameters requires a research effort using a mock-up of a timing system akin to what will be used on the actual engine.

The Choice of Encoders



Single Slot Encoder



BEI Three Track, 512/rev Encoder

The choice of encoder is a matter of convenience in design and manufacturing as well as interfacing it to the engine in the car. The Single Slot Encoder is easier to mechanically interface than the BEI Three Track, 512 per revolution Encoder. There are howerver, a few more problems to deal with. The non-detail approach is this:

Single Slot Encoder

Since solenoid valves are the 1st choice for several reasons, but not necessarily the best choice, timing advance and retard as well as dwell is a function of RPM and must be controlled by a suitable micro controller (henceforth "µ"). This is simply a matter of dealing with valve response time and its effect on performance and even more importantly, to achieve proper timing and dwell relative to varying engine speeds so as to avoid conflicts. One example of obvious conflict is when the valve is commanded open and the dwell is too great for the RPM. The net result is that as the power stroke is finished, and the piston begins its up-stroke, the valve is still open due to too long a dwell setting for a slower speed. This will inhibit engine performance drastically. Therefore, timing (the valve open command) and dwell (the duration of open) must be commensurate with RPM from moment to moment. The micro will be busy. The Single Slot Encoder will be mounted over the crankshaft on a stator plate attached to the crankcase front. A JK flip- Gasoline to LN2 flop in the toggle mode, triggered by the opto-interrupter will generate one pulse per rev whose width is a function of the time for one rev. The reciprocal of time is frequency, and 60 times frequency is RPM (RPM=1/T*60). It would be ideal if RPM is displayed on a digital read-out.

In a given cycle period, the beginning of a rev from TDC generates the first toggle pulse and sets the JK hi. The completion of this 1st rev generates the 2nd pulse and sets the JK low. Time per rev is now known and the advance or retard can be derived. If the valve is to be opened at 10° before TDC, degrees are converted to time (during the 2nd rev) and time is counted from the next toggle pulse (at the end of the 2nd rev) minus the time that represents 10° and the valve is issued an open command. And the cycle repeats. Along with the timing, dwell is calculated so that the valve is only open for the duration of piston travel from TDC to BDC, the theoretical max. As engine speed varies the timing and dwell adjust accordingly by the micro controller.

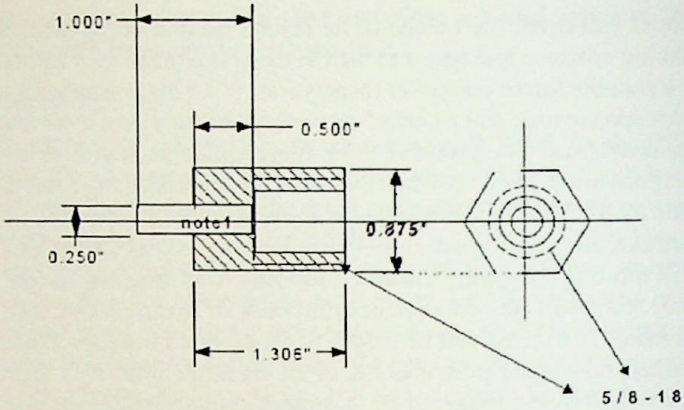
BEI Three Track, 512/rev Encoder

This encoder has tracks A and B with 512 pulses per revolution that are in quadrature (90° out). Track Z generates one pulse per revolution. If this is used, it must be driven directly from the crankshaft and suitably mounted. The hollow shaft must be interfaced properly. Pulses are counted per revolution for RPM and the 512 pulses represent 360° of shaft rotation. Timing is programmed accordingly, as is dwell, using the 512 per revolution pulses. Depending upon the speed of the µ (IPS Instructions per second), and its ability to count the pulses and set the advance and dwell, the decision between the three track and single slot encoder can be made. Ease of mounting is also a contributing factor in this decision, as is programming requirements and µ capability.

As can be seen from the data below, the use of a simple, single slot opto encoder considered at the very beginning, is now out of the question. An incremental encoder with at least two tracks is necessary along with a µController that can handle it suitably.

Encoder Mount

Since the Encoder measures the speed of the engine, it is important that the encoder be mounted to the crankshaft of the engine. To do this a method must be devised to attach and couple the encoder to the crank within a 7 inch space. Then the encoder and crankshaft must be aligned both horizontally and vertically. The encoder will be attached to the engine's crankshaft by means of a special adapter shown in Encoder Driver Nut figure below.

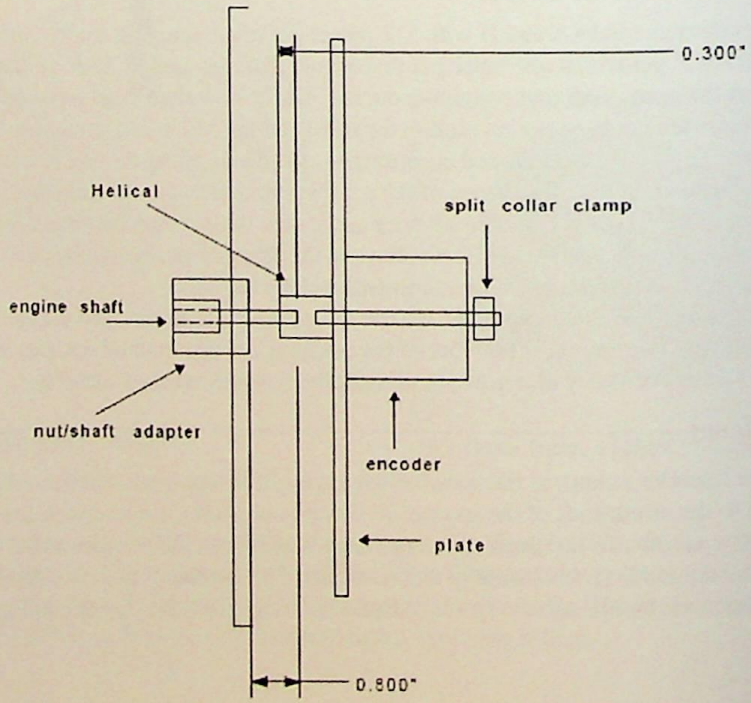


1. shaft is press-fit

Encoder Driver Nut

This adapter will screw onto the drive shaft thus retaining the flywheel as before. On the other end a quarter-inch diameter shaft will be press-fit half-inch into the adapter leaving another half-inch to protrude out. The protruding part of the shaft will be used to couple with the encoder shaft by a Helical ¼ inch to ¼ inch aluminum coupler. The Helical will couple both shafts together so that they may now rotate at the same speed. Spacers will be used to attach the encoder mounting plate to the crankcase to support the encoder; this is shown in the Side View figure below.

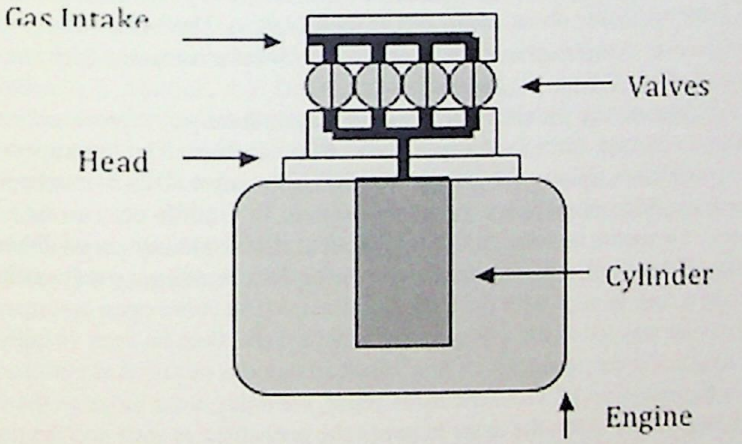
Side View



It is important that once the encoder is mounted there is no parallel or angular offsets to the alignment. If there were, the encoder would be worn out very quickly and readings will be affected. The technique that will be used is quite simple. First, the aforementioned nut adapter will be attached to the crankshaft then the Helical will be placed over the other end of the adapter. The Helical will have double sided tape attached to the other end so that when the aluminum plate is pressed against it, then lifted, the center of the shaft will be indicated on the encoder mounting plate by the Helical center hole.

Manifold

Since there will be more than one valve used to obtain enough volume throughput, a manifold must be created so that the output of each valve can be directed properly into the cylinder head. The manifold that is in the design prosess will consist of the valves sandwiched between two plates. The top plate will house the intake channel that will be fed to the supply end of the valve. Similarly, the bottom plate will house the output channel that flows into the cylinder head.



Manifold

Implementing the Timing Mechanism

The first micro controller considered was a Picaxe 08M. One critical element of this implementation is the ability of the µ to count the track A pulses starting immediately after the index pulse (1/rev on track Z). It is at this exact point that one more problem occurs. The count function in the Picaxe 08M is specified as "counts per unit time". The Parallax BS-2 SX is of the same persuasion. You assign the time allowed to accumulate a count, and it begins. This however renders it absolutely useless for this application since time would vary as RPM changed. The search began for a suitable µ that will handle interrupts, count discrete pulses, and have a high enough "IPS" (Instructions per Second) rating to operate as fast as the engine dictates. It would appear that the Mini-Max/51-C2 µController is capable of complying with these needs. As can be seen, the use of a simple, single slot opto encoder considered at the very beginning, is now totally out of the question.

Limits and Constraints

The incremental BEI H-20 encoder presents some interesting limits. The index pulse width at only 5 Cycles per second (CPS) which is 300 revolution per minute (RPM) is 250 µS, and at 50 CPS (3000 RPM) the pulse width is down to 20 µS. However, the 08M requires an absolute minimum of 290 µS and fails to interrupt and track at 289 µS. These numbers were derived by presenting the 08M with a Pulse Generator signal that has independently adjustable frequency and pulse width. By using this Generator as a pseudo encoder, the minimum pulse width (PW) that would reliably trigger the interrupt was 290 µS. The PW and frequency were exact and the Generator provided a digital read out. By placing the pulse train on Ch 1 of a scope and the µ generated pulse that is contrived after the interrupt on Ch 2 of the scope, one can determine when Ch 2 no longer tracks Ch 1 as soon as the Generator PW is reduced below 290 µS. So, it can easily be seen that under the best of conditions with the encoder (at 300 RPM) the narrow PW of only 250 µS falls short of the 290 by 50 µS. This is why the whole system performed perfectly using a Pulse Generator, and fell apart using the encoder.

The A track with 512 pulses/rev is even more restrictive than the Z Track. Running at 3000 RPM, 50 CPS, the PW of A track is 16 µS with a period/interval of 36 µS. And since 16 µS is nowhere near the minimum required of 290 µS by the 08M, the usage of the Picaxe 08M is totally obviated and out of the question. The Mini-Max/51-C2 µController however has a minimum pulse width of 360 nanoseconds which can easily track the period of 16 µS from the encoder.

Along with determining the above timing constraints, there was a profound curiosity to see the delays resulting from the solenoid valve response time. The interrupt is detected in the µ, and then follows the command to open the valve. This in itself generates a delay, but now the delay of the valve response is added. To visually observe the effect of valve response, a pressure transducer was fitted into a small containment chamber the approximate size of the combustion chamber volume, and the pressure signal was imposed upon the scope screen in sync with the track Z pulse, and the valve open command pulse. Air under pressure was fed to the valve and the delays could then be seen visually in real time which aids in the determination of how much advance is required at various RPM settings. At a frequency of 4 CPS of the index pulse, the delay from index to the start of pressure rise was 13 ms. Also, the delay between the pressure rise start and the peak pressure was 5 ms (air press =50 psi, valve dwell time was 10 ms).

At this juncture, it appears that the Mini-Max µC (Micro Controller) will handle both the interrupt function (capability of four) and will count the A track pulses without a time spec as well as the other mundane requirements. It also has 5 ADC units (10 bit) on board and the spec of 1 million IPS.

Conclusions

There are more details of design, but this is only a brief synopsis up to the present state of the project. A motor driven mock-up of an encoder system has been developed to test and study the control functions on the bench. The gasoline engine was removed from the cart, and the head and ignition system were removed. The encoder will later be transferred to the engine. Once the manifold is machined, the engine can run on the bench with compressed air from an electric air compressor. As stated earlier, the developed air engine will run on any form of compressed gas, be it air or nitrogen. Phase III will include placing the developed engine back into the vehicle and road testing.

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First in My Family: The Process and Journey from the Working Class to Professional Life

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Abstract

First-generation college students are underrepresented not only in undergraduate programs, but especially in post-baccalaureate programs. Currently there is not much research that specifically addresses the process first-generation students go through to obtain a Ph.D. degree or M.D degree. One objective of this research project is to understand and document the processes individuals go through to obtain their Ph.D. or M.D. degrees. In understanding this process, first generation undergraduate students may be encouraged to follow similar paths. The preliminary literature review focuses on demographics, motivation and attitudes, and the future plans of first-generation college students. This document is a preliminary literature review and will serve as a proposal and a guide to future research on this topic.

First-generation college students are underrepresented not only in undergraduate programs, but especially in post-baccalaureate programs. The sociological factors contributing to this phenomenon include race, income and the obvious fact that their parents did not attend college. For example, based on race, whites have outnumbered Hispanics, African American, American Indians, and Asian Americans, when obtaining PhD's. Even when these races are added together, their total is still less than that of whites (American Council on Education, 2007). How is this relevant to our study on first-generation students? According to the Nunez and Cuccaro-Alamin (1998), Hispanics and African Americans are the minorities with the highest number of first-generation college students. However, there are students who have overcome obstacles in pursuit of their advanced degrees. One objective of this research project is to understand and document the process these individuals go through in their pursuit of the highest levels of education. In understanding this process, first-generation college students may be encouraged to follow simi-

lar patterns. In reviewing the existing literature, it is evident there is a lack of research on first-generation students who have obtained advanced degrees. Therefore, the literature reviewed focuses on first-generation students who have or are in the process of completing their undergraduate studies. Important factors which must be considered are the demographics of first-generation students', motivation and preparation for college, and their future plans. All of the above factors contribute to trends we may see in the future and can lead to developing more effective methods of retaining this population of students. Recently, in 2007, the Higher Education Research Institute (HERI) published a report that reviews trends of first-generation college students. The HERI report focused on the importance of parental encouragement, students' reasons and motivations for going to college, students' financial concerns, influences derived from home life that affect the college choice process, students' academic preparation, and their goals and values at the college entry level (Saenz & Barrera, 2007). All of these factors must be taken into consideration in understanding how the experiences of first-generation students compare to their non-first generation peers.

Demographics

Characteristics of a First-Generation College Student

The population of first-generation college students has decreased in recent years. According to Saenz & Barrera (2007), from 1971 to 2005, the total percentage of first generation college students entering four year institutions declined from 38.5 percent to 15.9 percent (p.1). Another interesting demographic trend included African Americans and how their representation as "first-generation students" has decreased. This is not a good sign considering this trend is faster than the amount of African Americans who do not have a college education. Hispanics still are the least educated group in the general population. However, Hispanics have the highest amount of first-generation college students enrolled at four year institutions than any other race; this is because most Hispanics are children of immigrants (Saenz & Barrera, 2007). The National Center for Education Statistics conducted a report in 1998 which compared first-generation college students to non-first generation college students. There were several differences between the two groups. The major trends the authors found were that first-generation students tended be older, have lower incomes, were more likely to be married, and have dependents when compared to non-first-generation college students. Moreover, non-first-generation students were more likely to finish a four-year degree program. Educationally, first-generation students have lower GPA's in their first year of college and have weaker cognitive skills in reading, math, and critical thinking (Choy, 2001; Terenzini, 1995). Choy (2001) also discovered that first-generation status was associated with students who dropped out of a four year program before their second year. First-generations students were twice more likely to leave than those students whose parents had degrees. The same population of students was less likely than others to return to a four-year institution once they left. They are also more likely to attend school part time and attend public two-year institutions. In conjunction to these characteristics, students who worked while enrolled in a university were more likely to consider themselves employees before students (Choy, 2001). They work 35 or more hours per week and have low participation in campus activities. First-generation students usually came from families in the lowest income quartile (Nunez & Cuccaro Alamin, 1998). Their attitudes were different as well. First-generation college students care more about being well off financially in order to provide better opportunities for their children (Horn & Nunez, 2000). Gibbons and Shoffner (2004)

also compiled traits in which first-generation students differed from their peers. Students, whose parents never completed a degree, must apply to colleges without assistance from their parents. Their parents are not as experienced as parents with a college education and are not familiar with the application process. First-generation students differ in academic preparation and do not take courses as difficult as their peers while in high school. This can be an important factor as to why first-generation students are more likely to leave institutions sooner. If they are not prepared for their course load, they may not feel they will be able to complete higher level coursework later on in their degree path. Once again first-generation students interpret their college experience differently than their peers. They see college as the path to obtain a better paying job. Personality traits are often different between groups. First-generation students display that they are more likely to have lower self-esteem, humor, and creativity. These students, however, show a strong desire and willingness to continue their college education. They also identify themselves capable of receiving a college education just as any other student (Ginbbons & Schoffner, 2004).

Enrollment Statistics

In comparison to other students, first-generation students were less likely to enroll in four-year institutions and to attend full time for over a year (Choy, 2001). They were also less likely than other students to return to a four-year institution once they left. This group of students was more likely to attend a public two-year institution (Nunez & Cuccaro-Alamin, 1998). First-generation students made up most of the population at two-year institutions. If a student's parent had a degree, then the likelihood of the student attending school part time decreased. After graduating high school first generation students were more likely to delay their entry to a college or university when compared to their peers. This might explain why they are usually older than their counter parts. Even when controlling for other factors that may contribute to post-secondary enrollment, the trait of being a first-generation college student was still significant.

External Influences

Saenz & Barrera (2007) suggest that while the demographics of the first-generation student are changing, there are also changes in the common misconception that first-generation college students are at a disadvantage because of their parents' lack of college education. Both first-generation students and non-first generation students reported parental encouragement as a very important reason to attend college. Although this is a significant change from what many believe, this still does not explain the reasons why first-generation students are more likely to drop out of a four-year institution. Another influence that first-generation students have indicated as important is that high school counselors and family relatives are crucial when deciding what institution they are going to attend. In addition, when compared to their peers, first-generation students are more likely to attend a school closer to their home and have a job while attending school. These are both very important factors when choosing their school. First-generation students are less likely to live on campus during their freshman year and this choice can affect their academic and social integration during their transition to college (Saenz & Barrera, 2007, p.3). As a consequence, they must rely on outside help in order to have their questions answered or to receive guidance. Saenz & Barrera (2007) write "These relationships underscore the importance of familiar adults who can support students through their college decision-making process" (p.2).

Motivation and Preparation

Academic Preparation

Academic preparation is associated with student persistence toward long-term degree completion (Chen, 2005, p. 8). According to Choy (2001), there is a path to college enrollment that each student must go through. To begin this process students must decide they want to continue their education. Next, they must prepare academically for college-level work. Third, if they decide to attend a four-year institution they should complete the SAT or ACT. Next, students should choose colleges they are interested in and fill out application. Last, they must gain acceptance and file the necessary paperwork. Graduates whose parents did not attend college were less likely to complete each step. All students who plan to attend college should prepare while in high school. Therefore, students in high school should consider taking more difficult courses. According to Chen (2005), first-generation students do not show adequate academic preparation for college. This is demonstrated by their lower scores on senior achievement tests, lower college exam entrance scores, and lower rates of taking mathematics in high school (p.8). First-generation students were also less likely to have taken the SAT or ACT (Choy, 2001). Choy also found that high school mathematics is a strong indicator of whether or not a student will eventually enroll in a university. Seventy-six percent of 1992 high school graduates who took advanced mathematics courses had enrolled in a four-year institution by 1994 (p.12). Only six percent of students who took no mathematics or low level math courses enrolled in a four-year institution. The level of mathematics students take is strongly associated to parents' education. First-generation students who took advanced mathematics still had considerably lower enrollment rates than their non-first-generation peers. However, they had 30 percent better enrollment rates than their first-generation peers who did not take advanced mathematic courses. Another academic factor that contributed to the attainment of a bachelor's degree was students' high school curriculum. Students who followed a rigorous curriculum and took college level courses during high school were more likely to be successful in a four-year university. Parents who had a degree were more likely to help their children prepare for college by taking them to programs on educational opportunities, find information on financial aid, and accompany them on campus visits. Whether a student be first-generation or not, parental involvement in college planning activities was associated with higher enrollment rates.

Motivation and Attitudes

Motivation to attend college varies between first-generation and non-first-generation students. First-generation students are more likely to attend college in order to obtain a better paying job (Nunez & Cuccaro-Alamin, 1998). Terenzini (1995) writes, "A bachelor's degree has been considered a passport to the American middle class" (p.5). Colleges and universities are also major factors in allowing disadvantaged students to experience upward mobility in society. So what are the advantages of having a degree that motivate first-generation students to pursue education? Usually, first-generation students chose institutions based on cost-related factors, location-related factors, and reputation factors (Nunez & Cuccaro-Alamin, 1998). They were eleven percent more likely to choose and institution based on cost when compared to their peers. These students were also more likely to choose an institution because they felt they were more likely to finish a course of study in a shorter period of time. Another reason students chose their school was based on where they intended to live. They were more likely to cite that living at home, attending school close to home, and being able to work while attending school were very important to them. First-generation students also choose an institution if it had a better reputation of

placing students in jobs. These students were also asked what they considered important. Financial security was more important to them when compared to their peers. They were also less likely than their counterparts to report having political involvement and interest.

Towards Retention

Prospero & Vohra-Gupta (2007) discuss reasons why students remain in college. Two components the authors cite that contribute to the success of retention were academic and social integration. Academic integration is one component and is defined as the assimilation of the student in terms of education, energy of classroom, and anything having to do with their education in all respects. Social integration is the second component and refers to the assimilation of the student to the social life of the institution. This is also known as close friendships with student peers and involvement in student activities and events. These factors have been both known to increase the likelihood of college retention. Saenz and Barrera (2007) suggest programs should be created that focus on enhancing academic skills, developing study habits, and informing first-generation students what expectations professors have of them. This will help first-generation students adapt to university life. Terenzini (1995) agrees that there should be more emphasis placed on first-generation students and the support they need in order to transition smoothly. Programs should have academic support services that incorporate tutorial service, academic advising, and actively follow the student's progress. There are other forms of support that Rendon (1992) mentions as important. Students should receive "validating" experiences from faculty, administration, and their peers. This is defined as subtle signals that are sent to the student reassuring them that they are competent learners and have a rightful place in the academic community. She also feels that it is important that institutions and people reach out to first-generation students to ensure that each student feels comfortable enough to ask questions. Each institution should attempt to make contact with first-generation students by advertising what support services are being offered to them.

Labor and Workforce Participation

First-generations students cite that being well off financially is one of the reasons they attend post-secondary school. This is something that is gained with the attainment of a degree. First-generation students were able to hold and maintain jobs similar to their counterparts once they attained a bachelor's degree (Choy, 2001). Their salaries were similar as well. Further analysis of income showed differences due to gender, major, and institution where they graduated from, but not due to parents' education. This is a clear indicator that first-generation students are able to overcome obstacles and eventually gain access to the American middle class.

The Future

Degree Aspirations

There are few programs that concentrate on helping first-generation college students attend graduate school. It is an accomplishment in itself, for many of those students, to obtain an undergraduate degree from a university. But society is always changing and many first-generation college students have found ways to make post-baccalaureate education available to them. First-generation students generally have shown that they have lower degree aspirations when compared to their peers; this can be explained because of their lack of information about degree pathways or prior academic resources. In comparison to their counterparts, first-generation students are half as likely to aspire to a

bachelor's degree while in the tenth grade (Choy, 2001). The same students have lower educational expectations overall. High school students start making higher education plans between eighth and tenth grade. If first-generation students are convinced early in their secondary education that college is an obtainable goal for them, they may actually believe it. Choy (2001) suggests educators should intervene between eighth and ninth grade in order to make a successful impact. There has been an increase in interest in post-baccalaureate programs in the past three decades among both types of students (Saenz & Barrera, 2007). The Ronald E. McNair Post Baccalaureate Achievement Program is specifically directed towards first-generation college students who aspire to attain a post baccalaureate degree (U.S. Department of Education, 2007). The McNair program is one of the eight TRIO outreach programs designed to motivate and support students from disadvantaged backgrounds. The program is created ultimately to increase the number of doctoral degrees earned by students from underrepresented populations. The government funds four-year post secondary institutions and work with students while they are completing their undergraduate degrees. These students are prepared and then encouraged to attend graduate school and successfully complete an advanced degree program. The grants are awarded on a four year cycle, with the exception of the institutions that score in the top percent at the end of the cycle; those are awarded for five years (U.S. Department of Education, 2007). Most of the institutions provide the same type of program services to their students. The most common services provided to participants included counseling, mentoring, attending seminars and workshops, and admissions assistance (U.S. Department of Education, 2007). The figures provided by the Department of Education shows activities and services McNair participants receive. The U.S. Department of Education also provides information on the status and progress of previous McNair scholars. The data suggests there have been improvements over time when the participants stay with the program.

Methodology/Sampling

Methodology

A case study approach is defined as an in depth examination of one or few cases on many dimensions (Babbie & Maxfield, 2007). Case studies focus on one or some social phenomena (Frazier, 1976). The information will be collected by intensive interviews with at least fifty participants who have a Ph.D. or M.D. degree. This approach can be more useful because some information cannot be attained by quantitative data alone. Case studies offer different insights. According to Frazier (1976), case studies provide data that show the way social forces affect individuals and the way individuals affect social happenings. Some researchers feel that this method does not measure up to modern scientific standards because the researcher may interpret data in their favor. This method is also time consuming because the researcher must dedicate time to each participant as well as analyze the data to find correlations. It is suggested in Frazier's (1976) paper that researchers should include detailed information on procedures and discuss the relationships between the methods and findings. There are no uniform standards when attempting to use this method so the researcher must be careful and use integrity when collecting and analyzing information. A structured interview will also be used as well in order to collect demographic characteristics from each participant. The type of questions that will be asked include the age, gender, income, and marital status of the respondent. Also information will be obtained on their parents' occupation and level of education.

Sampling

The approach that will be used in this research to obtain participants is snowball sampling. This is when a single subject is identified and then the subject is asked to identify other similar subjects that would be willing to participate in the study (Maxfield & Babbie, 2007). This technique is often used when it is difficult to find participants.

Research Questions

In order to gain an understanding of the process these individuals have gone through, we will attempt to answer the following questions:

- What are the lived experiences of the men and women who obtain their advanced degrees?
- What factors, events, experiences and/or people influenced them the most?
- In what manner did these factors, events, experiences or people influence them?
- Do males and females report similar experiences or do they differ?

Conclusion

Colleges are beginning to realize the importance of first-generation students and what actions must be taken in order to have continuous retention. It is apparent that finances are an important factor when choosing to attend college or not. If school is more available to these students, the more likely they will feel that it is attainable. Another important factor is how first-generation students heavily rely on adults other than their parents to guide them in the right direction (Saenz & Barrera, 2007). This type of information can be used by colleges to target these adults in high schools where first-generation students are abundant.

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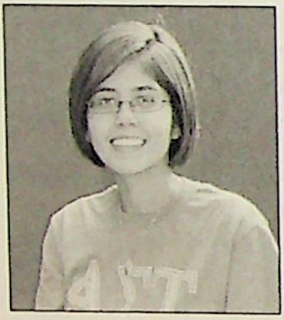
Today's Middle Schools: A Philosophical & Psychological Critique of Policy & Practice



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Abstract

Although much research has been done identifying different aspects of the education system that need to be reformed we must continue to review and critique our education system. In order to continue the growth and development of the education system the current research works to review the mismatches between the education system and developmental and motivational psychology. The current study attempts to link the education policy in terms of the "No Child Left Behind Act," high-stakes testing, as well as John Dewey's philosophy of education to the mismatches in the developmental stages of early adolescence. Previous research suggests that the education policies do not follow the cognitive, physical, and social development of middle schoolers which is a major cause for concern (Brinthaupt & Lipka, 2002). The lack of interest in school which middle schoolers develop has also been correlated with the following motivational psychology theories: flow theory, achievement goal theory, and theories which identify the differences between intrinsic and extrinsic motivation. The intrinsic motivation that needs to be developed by early adolescents is actually decreasing as children go through the transition of middle school as they shift toward extrinsic performance orientations. In seeking to understand this trend the present study works toward links the issues of early adolescent disengagement to recent research in motivational psychology, developmental psychology, public policy, and, ultimately, with the philosophy of education.

As John Dewey once stated, "I believe that education…is a process of living and not a preparation for future living," (McDermott, 1973, p. 445). Suggesting that education should be a process of life instead of preparation for the future the current research looks to review the mismatches between the education system and the developmental stages of early adolescence which have been shown to lead to a lack of interest in school of middle

school aged children. Using John Dewey's philosophy of education to link developmental and motivational psychology as well as the legal aspect of the education system we search to further develop the current research in order to reform our education system. Thus, in order to increase the motivation of students in middle school we must critique the current mismatches between the education system and the main developmental theories of early adolescence so that we may reform the education system.

Education Policy in the United States: The Rise of High-Stakes Accountability

Inquiry concerning the academic disengagement of early adolescents requires at least two parallel lines of questioning. On the one hand, researchers must address the lives of the children studied, that is, the physical, cognitive, emotional, cultural, and social context of early adolescence. At the same time, researchers must look into the schools themselves, examining the educational environment in which students become disengaged. And this account of the educational environment in which early adolescents find themselves must include a survey of the policy landscape that shapes our schools. From governance structures and budget allotments to curriculum and instructional methods, policymakers have enormous sway over the day-to-day functioning of schools.

Over the past several decades U.S. policymakers implemented educational reforms explicitly and emphatically built around standardized achievement test results. Though standardized achievement testing in the U.S. dates back at least to the nineteenth century (Sacks, 1999, p. 69), the education conversation became dominated by the rhetoric of testing in the mid-twentieth century. In 1965, the Elementary and Secondary Education Act (ESEA) allocated federal funds to help financially challenged schools in communities with high levels of poverty. As an accountability measure (i.e., to ensure effective and appropriate use of the funds), ESEA's Title 1 required norm-referenced standardized testing for all schools receiving the federal funding. Subsequent reauthorizations of ESEA, including the Improving America's Schools Act of 1994 (IASA) and the No Child Left Behind Act of 2001 (NCLB), expanded both the frequency and the stakes of such norm-referenced testing. IASA extended mandatory reading and math testing to once during grades 3 through 5, once during 6 through 9, and once during 10 through 12. Under IASA, schools that failed to meet test-performance standards could be subject to state-level sanctions, including withheld Title 1 funds or transfer of students. In the name of strengthening accountability, NCLB further expanded the testing frequency for grades 3 through 8, mandating annual reading and math tests for all students in those grades. (In addition, the law now requires science testing once in grades 3-5, 6-9, and 10-12.) The law also requires students in grades 4 through 8 to take the National Assessment of Educational Progress reading and math assessment (NAEP) every 2 years. NCLB also raised the stakes of these tests for schools, teachers, and students alike. Under NCLB, states are required to offer transfer and supplemental educational services (from either the private or public sector providers) to all students enrolled in schools who fail to meet state-defined assessment-performance goals for two consecutive years.

NCLB's efforts at standards-based reform make standardized testing the central facet of public education in the United States. The law diminishes aspects of education that previously played central roles—curricula, course content, learning outcomes, instructional methods, school organization, teacher training, and the like—to spokes on a wheel which has as its hub the norm-referenced, one-size-fits-all standardized test. The reorganization of educational thinking and practice has had considerable effects upon the daily life of our schools. In what follows, we shall briefly explore some of the most well documented effects.

Curricular Narrowing

One major consequence of the emphasis upon high-stakes standardized testing has been the narrowing of school curricula. With federal funding made contingent upon improvement in core subjects such as math, reading, and science, non-core subjects have been cut or scaled back in many school districts. Courses such as art, music, history, foreign languages, and social studies have been reduced or eliminated in many schools in an effort to make more time for tested subjects. For example, Jastrow and Jane (2006) report that a California middle school required students to take two periods of core subjects and simultaneously cut funding for music, art, Spanish, and occupational classes (cited in Nichols, 2008, p. 15). The Center on Education Policy reported that "approximately 62% of school districts increased the amount of time spent in elementary schools on English language arts and/or math, while 44% of districts cut time on science, social studies, art and music, physical education, lunch or recess" (McMurrer, 2007, p. 2).

High-stakes testing has also contributed to a narrowing of the scope and depth of what is taught in core courses. Here, tested content is emphasized at the expense of non-tested content. With NCLB's explicit demand that curricula be aligned with state standards and assessments, school districts have increasingly selected textbooks and other classroom materials designed around assessment content. In 2007, 79% of middle schools (and 84% of elementary schools) reported changing their English language arts curricula "somewhat" or "to a great extent" in an attempt to emphasize tested content (McMurrer, 2007). In a concrete sense, the curriculum adapts to the high-stakes testing culture by neglecting material not covered by the tests, including "reading real books, writing in authentic contexts, solving higher-order problems, creative and divergent thinking projects, longer-term integrative unit projects...." (Smith, et. al., 1987, p. 268). Also neglected are community- and culture-specific materials. One teacher, for example, notes that as a result of school district pressure to focus on tested content, "We don't do community outreach like we used to, like visiting the nursing home or cleaning up the park we adopted"(Shepard, Kinner, & Rosenthal, 2003, p. 14, cited in Nichols, 2008).

Emphasis on Test-Taking Skills

Just as the informational content narrows due to high-stakes testing, so too do the skills developed through classroom work. Here again, test-taking skills are emphasized at the expense of habits of inquiry. As entering the correct response is the only thing that matters in determining the score on a multiple-choice exam, such tests do not discriminate between correct responses reached through a thorough understanding of the concepts and those responses reached by process of elimination, educated guessing, or even arbitrary selection. And, as instruction in higher-order understanding of concepts and underlying ideas is limited by curricular narrowing, one would expect that teachers might emphasize test-taking skills in their classrooms. Indeed, research show that this is precisely what happens. McMillan, Myran, and Workman (2002) show that high-stakes assessments in Virginia have led to secondary teachers using more multiple-choice items in their classroom assessments. Shepard & Dougherty demonstrate that a majority of teachers report spending at least two weeks "giving students commercially produced test preparation materials, giving practice tests, and instructing students on test-taking strategies" (Shepard & Dougherty, 1991, p. 7).In addition to the two or more weeks of test-preparation, students spend anywhere from 3 to 11 days actually taking the exams (ibid.). As such, most studies indicate that high-stakes testing has led to a more than 20-day decrease in instructional time per academic year (Noble & Smith, 1994).

Teacher-Centered Pedagogies

As preparation for state assessments has become more central to schoolwork, teachers rely upon pedagogical techniques geared toward enhancing test performance, often at the expense of those techniques that have been shown to promote self-direction and engagement of student interest. Teachers in high-stakes testing environments spend more classroom time on lecture, drills, and assignments where students work in isolation for one another (Journell, 2007; McNeil & Valenzuela, 2000; Passman, 2000), despite the overwhelming evidence that more student-centered pedagogies (e.g. active learning, cooperative learning, and problem-based learning methods) result in not only greater comprehension and retention of information, but also in enhanced student motivation and engagement in the learning process (Passman, 2000; Noble, 1994; Anderman, 1992).

High-Stakes Testing and the School Environment

As the classroom exists as part of a larger school structure, the broader effects of high-stakes testing on school administration, teachers' motivation and morale, and on teacher dropout rates, have an indirect effect upon student learning and motivation. Many studies from around the United States that demonstrate that high-stakes testing negatively impacts teachers. For example, Smith and Rottenberg (1991) show a decline teachers' sense of professional autonomy and authority correlated to a rise in high-stakes testing (cited in Noble & Smith, 1994). Moreover, teachers' express significant anxiety about the conflict between the test-centered pedagogies they are forced to adopt in a high-stakes environment (Hatch & Freeman, 1988, cited in Noble & Smith, 1994). As a result, teachers express the sense that the profession of teaching is "being deskilled by tests" (Hoffman, et. al., 2003). Uncomfortable with the professional environment created by high-stakes testing, teachers (particularly new teachers) are leaving the profession at increasingly higher rates (U.S. Department of Education, 2008; Lambert, 2006). Teacher turnover affects students in several ways. First, as a result of increased turnover rates, more students find themselves in classrooms led by teachers new to the profession, the school, and, often, the community. Second, as teachers leave, their positions are increasingly difficult to fill, resulting in more classrooms being staffed by substitute teachers and teachers who have received emergency certification (U.S. Department of Education, 2008).

Thus the state of affairs in schools today reflects is many ways the climate of high-stakes testing. However, the question of how this educational climate impacts student motivation remains. And as our guiding concern is with the deterioration of academic motivation in middle grade students, we turn now to a more detailed examination the psychology of early adolescence. In order to understand the impact of the contemporary education system on early adolescence in particular we turn now to a discussion of the developmental psychology of early adolescence. Here we seek to understand the "lack of interest" problem by linking together research on developmental psychology with the above analysis of contemporary schools. The transition from childhood to early adolescence is a time of drastic changes in all aspects of life which is a major cause for concern when trying to analyze the "lack of interest" issue at hand (Brinthaupt & Lipka, 2002). In what follows we will consider the physical, social, and cognitive changes that serve as the backdrop of early adolescents' educational identities.

The Developmental Changes of Early Adolescence

Early adolescence marks the beginning of the biggest physical change of life, known as puberty. Puberty is a time of raging hormones and changing attitudes. Physical change establishes a sense of rearrangement of priorities that, research suggests, may contribute to school and education being placed on the "back-burner" (Brinthaupt & Lipka, 2002).

Early adolescents need encouragement and constant reassurance about their physical development (Caissy, 1994). The deterioration of intrinsic interest and motivation in education has been linked to early adolescents' consuming thoughts about physical appearance (Caissy, 1994). While going through puberty early adolescents tend to focus more on physical appearance rather than academic achievement (Caissy, 1994).

Another trying aspect of early adolescence is social change. During early adolescence students begin to show a need for greater independence from family as well as a greater need for peer relations (Brinthaupt & Lipka, 2002). Studies have shown that peer relationships, along with parent and teacher relationships, play a significant role in academic achievement for early adolescents (Furrer & Skinner, 2003; Wentzel, 1998; Wentzel, Barry, & Caldwell, 2004). Supportive, interactive, and positive relationships seem to be linked to increased levels of academic achievement and engagement whereas controlling, unsupportive, negative relationships with peers, teachers, and parents seem to decrease levels of academic achievement and engagement in school (Furrer & Skinner, 2003; Wentzel, Barry, & Caldwell, 2004). When students feel a sense of connectedness to their parents and teachers they tend to feel cared for and respected which then jump starts the search for success in school (Connell & Klem, 2006; Furrer & Skinner, 2003; Juvonen, 2008; Klem & Connell, 2004; Thompson, 2008). Throughout early adolescence children need to be given a sense of independence at school and at home; however, early adolescents still need to feel connected to their parents, have a sense of belonging within their peers, and be supported and encouraged by their teachers (Furrer & Skinner, 2003; Wentzel, 1998; Wentzel, Barry, & Caldwell, 2004). Although autonomy is key, relationships carry a higher importance and intensity rating when allied with academic achievement and self-competence in school and life (Brinthaupt & Lipka, 2002).

The cognitive shift from middle childhood to adolescence establishes an emphasis on a social exterior and psychological interior where a child begins to think of the self in a more complex manner (Brinthaupt & Lipka, 2002). A younger child thinks of the self in terms of overt, external dimensions which include personal attributes and possessions, features of the body and categorical self, and typical and preferred activities whereas the older child/early adolescent begins to think of the self in an internal, covert, psychological way that includes thoughts about traits and attitudes (Brinthaupt & Lipka, 2002). Self-descriptions and self-perceptions change from a childhood emphasis on the visual and observable, to an early adolescent emphasis on the abstract and conceptual (Brinthaupt & Lipka, 2002). The early adolescent begins to focus on more realistic thoughts and thus become less positive and idealistic (Brinthaupt & Lipka, 2002). The realistic characteristic gained by early adolescents involves becoming aware of our limitations with reference to our capabilities and being able to distinguish idealistic fantasies from realistic possibilities. For example, any young child thinks that he can do anything and accomplish everything without struggle or drawbacks whereas an early adolescent begins to understand that he/she has certain strengths and weaknesses that may keep him from accomplishing some goals or certain tasks. The adolescent starts thinking "who am I?" and "what am I?" According to Erik Erikson the early adolescent is in search for self and identity, the self being "who am I?" and the identity being "what am I?" A person has one self made up of multiple identities that are difficult to develop and establish when one is going through social and physical changes along with cognitive changes. The self, as defined by many, is an overall sense of being which includes one's attributes, characteristics, capacities, and preferences (Brinthaupt & Lipka, 2002). On the other hand, the multiple identities that comprise the self are aspects that are "accessible and salient in a particular context, that interact with environment, and to which a person is committed" (Brinthaupt & Lipka, 2002, p. 28).

One of the common identities developed by children is an academic identity. An academic identity is a type of identity developed by all which is characteristic of how one act in the academic arena. Because early adolescence is a difficult period for children (cognitively, physically, and socially), students making the transition into middle school are more self-conscious and less confident in their academic abilities (Simmons, 1993). Struggles with selfhood and academic identity create deterioration of perceived scholastic competence and actual academic performance (Harter, 1992). "Adolescents' identities as middle schoolers are reflected in the kinds of goals, efficacy beliefs, and emotions that characterize them as they go about interacting with peers and teachers" (Brinthaupt & Lipka, 2002, p. 103). Middle-grade students form low academic identities and lose confidence thus, the more negativity about performance and abilities in school, the less likely one is to improve and/or perform well (Brinthaupt & Lipka, 2002). As research has shown, the deterioration in self-perceptions and perceptions of performance (self-competence) in early adolescence is exacerbated by the move to middle school (Midgley & Edelin, 1998; Yeung & McInerney, 2005).

Previous research suggests that when a student makes the transition into middle school the self-competence level decreases (Brinthaupt & Lipka, 2002; Obach, 2003). Studies have also shown that poor self-competence was associated with poor academic achievement in the seventh and eighth grade (Roeser & Eccles, 1998). Thus, the middle school transition is associated with declining self-competence, which, in turn, is associated with declining academic achievement. When speaking of self-competence and self-efficacy, we refer to how the adolescent feels about his/her abilities, which are basically like asking the question "what can/can't I do," and "how well can I do it?" Self-competence and self-efficacy are similar concepts that help to describe how a student feels about his/her own abilities which are causes for concern for middle school children that we must take into account. Research has shown that young children tend to overestimate their competence, whereas early adolescents seem to be more realistic in the sense that one begins to fully understand what he/she is truly capable of rather having a sort of fantasy perspective where one thinks he/she can truly do anything and everything ((Zanobini & Usai, 2002). For example younger children believe that some how they can ttruly fly where as an early adolescent begins to understand that he/she cannot fly due to tthe lack of wings. The new sense of realism in which early adolescents are coming tot tterms with is linked to the realization that they may need tot work harder in some areas cof academics rather than others. Furthermore the early adolescent realism is also related tto decreasing levels of self-efficacy due to the drop in the positive "I can do anything aattitude" which young elementary students have. Students with low levels of self-efficacy dido not feel the possibility of achieving their academic goals and aspirations which creates aa further decrease in levels of self-efficacy (Linnenbrink & Pintrich, 2003). Hence, one ccan conclude that, "students who have positive and relatively high self-efficacy beliefs wwill be more likely to be engaged in the classroom" (Linnenbrink & Pintrich, 2003, p. 1136) and academically achieve success. Self-efficacy and self-competence are linked to sstudent engagement because if a student has high levels of self-efficacy/self-competence tthen he/she will feel he can do something and be more engaged in doing it. On the other haand if a student doesn't think highly of his capabilities then he is said to have low levels oof self-efficacy/self-competence in which the student becomes disengaged in an activity boecause lets face it nobody wants do something they feel they can't.

Research suggests that early adolescents need support in the following areas: autconomy, competence, and relatedness (Brinthaupt & Lipka, 2002). More specifically, the nneed for support of students' autonomy involves promoting the adoption of mastery of aacademic goals, enhancing feelings of belonging at school and in each classroom, and

nurturing subject matter values and interests (Brinthaupt & Lipka, 2002). The need for support of student competence includes providing challenging tasks, opportunities for assisted performance, and clear academic behavioral goals and expectations which create a sense of academic mastery, strengthens the feeling of pride in a job well done, and encourage the student to adopt positive, achieving academic behavioral goals and meet academic and behavioral expectations of success, good grades, and excellent conduct (Brinthaupt & Lipka, 2002). Finally, the need for support of student relatedness suggests the use of cooperative learning techniques, the creation of school culture, the presence of themes of care in the curriculum, the division of students into a smaller block of teachers and students throughout the day, and the teacher's daily actions and attitudes toward the students (Brinthaupt & Lipka, 2002). More specifically if students are divided into smaller student-teacher blocks they will be assigned only a few teachers and will be grouped with a small amount of students creating the sense of stability early adolescents need. By providing this support the school enhances the experience of students and the students' bonding to the school, classmates, and teachers (Brinthaupt & Lipka, 2002).

Contemporary Schools Failures in Supporting Early Adolescents

Researchers have shown that the structures and curricula of most middle schools fail to meet the needs of early adolescence and, further, that this failure contributes to the deterioration of the academic interest and motivation of middle school students (Brinthaupt & Lipka, 2002; Juvonen, 2007; Midgley & Edelin, 1998). Thus Juvonen explains, "A volatile mismatch exists between the organization [and curriculum] of middle grades schools, and the intellectual, emotional, and interpersonal needs of young adolescents" (Juvonen, 2007, p. 198). Although one of the most important goals of middle level education is to have early adolescents make significant progress towards personal and social development, middle schools are still not achieving this goal (Caissy, 1994). As the disparities between the environment of schools and the needs of students lie at the heart of this failure we turn now to examine these mismatches in greater detail.

Research suggests that one of the main reasons students lose interest in school is the mismatch between middle school structure and early adolescence (Brinthaupt & Lipka, 2002). Negative changes in motivation and achievement in middle school have been linked to mismatches between developmental needs and academic and social opportunities characteristic of new middle school settings (Brinthaupt & Lipka, 2002). Early adolescents' negative change in behavior is due in part to the mismatch between development of early adolescence and structure of typical middle grades which leads to disengagement in education altogether (Brinthaupt & Lipka, 2002). The five major mismatches identified by researchers include school size, student-teacher relationships, teacher/parental control/autonomy, competition and comparison, and challenge. Specifically middle schools tend to increase greatly in size at a time when a student needs more support, personal attention, and stability from peers and teachers (Brinthaupt & Lipka, 2002; Midgley & Edelin, 1998). Bigger middle schools have too many students which cause a lack of personal classroom setting and personal attention, thus decreasing the chances of engaging a student (Brinthaupt & Lipka, 2002). In terms of the student-teacher relationship, having several classes and teachers in one day means less contact between student, teacher, and peers. The lack of continuous interpersonal relations contributes to forming an unstable atmosphere, despite the early adolescents' need for more stability and support (Brinthaupt & Lipka, 2002). Previous studies have linked the lack of student-teacher and peer interaction and connection to a decrease in students' interest in school and a decrease in academic performance (Furrer & Skinner, 2003; Juvonen, 2007). Additionally, the increasing number of teacher turnover rates associated with high-stakes testing has abruptly

affected the stability of student-teacher relationships (U.S. Department of Education, 2008; Lambert, 2006).

The deterioration of these relationships also disrupts early adolescents' social networks at a time when middle schoolers are extremely concerned with relationships with teachers and peers, who often serve as role models outside the home environment (Eccles, 1993; Midgley & Edelin, 1998). Researchers have found that students need caring, supportive, positive, and encouraging teachers who develop good relationships with the students in order for the students to academically achieve success in middle school and stay engaged in school (Juvonen, 2007; Klem & Connell, 2004; Roeser & Eccles, 1998; Thompson, 2008). Because teacher support is such a significant predictor of early adolescents' motivation and academic achievement one must take the decreases in student-teacher connections as a serious cause for concern (Wentzel, 1997). By decorating classrooms less creatively, making them look more bland and unfriendly and implementing more of an organized, disciplinary environment in the classroom one is organizing a room to enhance teacher control so that students don't feel like school can be a time to play and have fun anymore rather a place of purely structured education and academic success. As classrooms are being organized to enhance teacher control one must stop to think about how this impacts students' needs for autonomy. Parents and teachers have such a strong impact on students that creating a strong controlling and disciplinary attitude towards early adolescents may create an unhealthy parent-child relationship as well as an untrusting teacher-student relationship which deteriorates a child's academic performance, achievement, and motivation (Furrer & Skinner, 2003). For example, unhealthy parent-child relationships may be characterized as those in which the parent is an over-board controlling, disciplinarian that the child does not feel comfortable around his/her own parents anymore because they feel so trapped and suffocated. Another example may be that through the negative, controlling characteristic of a teacher in the classroom the student feels as though the teacher doesn't trust him/her and therefore in return does not trust the teacher anymore. When parents are more involved with their children's education, students report more effort and interest in school (De-Hass, Willems, & Holbein, 2005). As stated previously, early adolescents also need support for autonomy, therefore the more that parents and teachers support autonomy, the more supported the student feels and more positivity the student feels about school activities (Assor, Kaplan, & Roth, 2002). Parents and teachers must, therefore, find the right balance between giving support and staying involved with the students' academic life as well as to allow autonomy and not go overboard with the controlling, disciplinarian attitude. Schools and teachers seem to tighten up the reigns just as students feel the need for more autonomy (Lepper, Corpus, & Iyengar, 2005). "The essence of autonomy enhancement is not minimization of the educator's presence, but making the educator's presence useful for the student who strives to formulate and realize personal goals and interests" (Assor, Kaplan, & Roth, 2002, p. 273). Not only are teachers increasing the amount of control placed on the students in the classroom but research also suggests that teachers are encouraging a competitive atmosphere and attitude at a time when students are the least secure with themselves (Brinthaupt & Lipka, 2002). One of the causes of the increased teacher controlled atmosphere is the pressure of achievement of students on high-stakes tests. . Because teachers are being forced to focus more on achievement on high-stakes testing, the controlled atmosphere continues to increase (McMurrer, 2007; Smith et al., 1987). The demands of high-stakes testing require a more rigorously teacher-controlled and competitive environment, thus increasing the controlled classroom atmosphere and competitive emphasis on the students to an outrageous degree (McMurrer, 2007; Smith et al., 1987). Teachers' emphasis on competitiveness and social comparison (i.e., when

students are forced to focus on how one compares to another in terms of academic achievement) creates a negative atmosphere in the classroom and develops negativity within the students (Raffini, 1986). When a student's self competence is questioned, especially during this trying period of early adolescence, the student puts up a wall which he or she begins to feel unworthy and the interest in school as well as the motivation to achieve dramatically decreases as the year's progress beginning at the middle school years (Raffini, 1986). We must realize that trying to emphasize competition and social comparison at a time when students are trying to figure out who they are and what they are capable of makes the process of developing and moving past the insecurities of early adolescence more difficult than it should be.

At the same time, the curriculum emphasizes lower levels of cognitive strategies at a time when ability to use higher level strategies is increasing; meaning that less cognitively challenging work is being given to middle schoolers. Research indicates that the failure to engage these nascent cognitive capacities contributes to students' lack of interest and boredom in school (Brinthaupt & Lipka, 2002; Schweinle, Turner, & Meyer, 2006). One of the main causes for the implementation of lower level cognitive strategies is the high-stakes tests. Since high-stakes tests are set on a lower cognitive bar we have a major cause for concern because instead of helping students achieve higher-levels of education these standardized tests are keeping students at a lower cognitive level at a time where higher level strategies are needed. The standardized tests are holding early adolescents back rather than helping them achieve a higher level of educational development. Focusing on the mismatches between the middle school education system and the developmental stages of early adolescents one must keep trying to strike the right balance between the structures of the education system for middle schoolers, the developmental psychology of education, along with motivational psychology of education, to be further discussed.

Development and Engagement in Early Adolescence

The physical, cognitive, and social changes of early adolescence contribute to a shift in motivational needs. Accordingly, we now turn to a discussion of the four dominant theories of motivational psychology, seeking their insights into the transformative period of early adolescence. As research has shown, "students become more disengaged from school as they progress from elementary to middle to high school" (Klem & Connell, 2004, p. 262); more specifically, by high school 40% to 60% of students become disengaged from school (Klem & Connell, 2004). Basically, we have a major motivational problem here that is another focal point for the current research. Something is taking place during the transition into middle school which is contributing to a tremendous lack of motivation in students today. Accordingly we must examine the motivational orientations of early adolescence. We shall discuss, among other things, Flow Theory, Achievement Goal Theory, and intrinsic/extrinsic motivational techniques in an attempt to gain insight into what is truly causing middle-grades students to drop off the motivated and interested scale.

Flow Theory suggests that a balance between perceived challenge and skill is necessary for an optimal performance experience (Barry, 2007). For example, if the task is too easy and the student's skill level is high, boredom results; if the task is too difficult and the student's skill level is low then frustration and anxiety occur; and if both skill level and challenge level are low the student may become indifferent (Barry, 2007). As a result, in order to achieve "flow," "the challenge must be presented continually as the student develops new skills so the teacher must keep moving the student forward" (Barry, 2007, p. 25). As with Michael Jordan for example, who developed a widespread knowledge and skill for basketball, we can see this perfect achievement of "flow" develop innately in his

performance at every game (Black, 2008). The feeling of flow Michael Jordan developed, as he describes, was " the ability to instantly 'see' how to control the court-how to set the pace of the play, figure out how teammates and the opposing team would react to his moves, and clear a path to the basket" (Black, 2008, p. 41). Michael Jordan was able to slow down the game and visualize the best options on the court; he gained the right "flow." Furthermore, this optimal experience or "flow" is when the student perceives the challenge or task and his or her own abilities/skills as balanced and above average (Schweinle, Turner, & Meyer, 2006). Flow Theory holds that the individual's sense of balance between challenge and ability is the hallmark of engagement that accordingly, authentic engagement requires attention to internal reasons instead of external reasons for the performance of a given task.

Like Flow Theory, motivational theories that emphasize a conflict between intrinsic and extrinsic motivation offer insights into the various motivational methods that students are exposed to throughout their education. The orientation that a student develops can highly reflect on how one achieves academic success and even if one achieves academic success. On the one hand intrinsic motivation involves the internal desire to engage in a task for reasons of enjoyment, challenge, pleasure, and interest. On the other hand extrinsic motivation involves participating in a task only for the external rewards one may receive by performing this task. Ultimately achieving students who are intrinsically motivated is the key in order to have students continuously engaged in school.

Studies show that the increasing importance of grades and test accompanies a dramatic decline in intrinsic motivation (Lepper, Corpus, & Iyenger, 2005). The increasing importance of grades and test scores discussed earlier has increased this shift, moving students away from intrinsic motivation and into extrinsic motivation. Furthermore, positive correlations between academic achievement and intrinsic motivation have also been fount (Lepper, Corpus, & Iyenger, 2005). Because students develop negative attitudes about school and themselves as they are going through the trying stages of early adolescence they become more anxious and nervous about performance (Zanobini & Usai, 2002). Therefore, as students' performance anxiety increases academic achievement decreases because the more anxious and nervous one is, the less likely one will be able to give 100% effort, which then creates room for error under pressure causing the chances for academic success to decrease. So what we have is a continuous decrease in love and enjoyment for school due to the added stress of extrinsic factors such as grades and test scores (Lepper, Corpus, & Iyenger, 2005). Overall students who become adapted to an intrinsically motivated nature are in search of "what is rewarding rather than what is rewarded" (Bowman, 2007, p. 83). Thus we conclude that intrinsically motivated students engage in school and achieve academic success.

Related to intrinsic and extrinsic motivation is the Achievement Goal Theory which posits two types of goal orientations performance goal orientation and mastery goal orientation. These goal orientations represent reasons why students try to gain academic achievement in school (Wentzel, 1998). A performance oriented attitude is expressed when a child works extremely hard to demonstrate their skills; whereas a mastery-oriented attitude is expressed when a child works toward improving their competencies (Zanobini & Usai, 2002). Thus, the difference lies between the two lies in the demonstrating vs. improving nature of the orientations. Mastery-oriented students are more resilient to failure and persist in efforts for achievement (Barry, 2007). Performance-oriented children focus on external motivational factors such as getting good grades and test scores and mastery-oriented children tend to be more intrinsically motivated, meaning the student tends to finding internal interest and joy in challenge and learning.

Indeed, research has shown a significant drop in mastery orientation from Grade 7 to

Grade 9 (Yeung & McInerney, 2005). Studies have also shown that performance-oriented goals tend to create negative achievement beliefs-beliefs in what one can actually achieve and has the capability to achieve-however mastery-oriented goals tend to create positive attitudes toward school and higher self-competence which means positive feelings of one's abilities increasing the engagement of a student in school (Brinthaupt & Lipka, 2002). Evidence shows that mastery goals are emphasized more in elementary school setting in comparison to the middle school setting (Midgley & Edelin, 1998). The reason for the difference in orientation goal setting between elementary school and middle school is the severity of influence of high-stakes testing previously discussed. Because the pressure of performance on tests rises from elementary school to middle school we see a drastic shift in goal orientations. As middle schools increase focus on performance students become more performance-oriented as well as extrinsically motivated. Accordingly, it seems as though we must move toward creating a more mastery-oriented structure in middle school in order to increase the intrinsic motivation in students.

Above all, we must move toward creating an education system that supports and draws upon students' intrinsic motivation. For, as John Dewey insists, the danger of education is not in teaching children only what they wish to learn. Rather, the danger is that we might forget that children will learn only what they are interested in learning (Dewey, 1997). The task for educators and policy-makers, then, is to find a way to nurture and guide the development of students' interests toward that which will enable the individual student and her/his community to flourish.

Philosophy of Education: What is Education Anyhow?

We have now surveyed the educational environment of contemporary schools, and have detailed the ways in which contemporary schools' overreliance upon extrinsic motivation (through, in particular, the high-stakes assessment climate so prevalent today) mismatches with the motivational and developmental needs of early adolescents. These mismatches serve as the most salient response to our guiding question: what is it about contemporary education that causes or exacerbates academic disengagement in middle grades students?

And yet, our inquiry into how students become disengaged presumes, perhaps improperly, the value of academic engagement. That is, research into academic motivation, the causes of its decline, and the most effective methods for sustaining and enhancing student engagement rests upon the assumption that self-motivation and engagement are good things for our students to have. But is academic engagement so important? Should our pursuit of engagement take precedence over the acquisition of information and skills necessary to become an effective worker and citizen? After all, the latest surge in high-stakes testing began in 1983, when A Nation at Risk warned that progressive education had caused a "rising tide of mediocrity" by which the United States' ability to compete in the international market had been seriously damaged. "Knowledge, learning, information, and skilled intelligence are the new raw materials of international commerce," the document warns; and thus, "if only to keep and improve on the slim competitive edge we still retain in world markets, we must reform our educational system.... Learning is the indispensable investment required for success in the 'information age' we are entering" (National Commission on Excellence in Education, 1983, pp. 6-7). The basic complaint that marked the latest upsurge of "accountability" rhetoric runs along these lines: so-called "progressive" pedagogies reduce the teaching of essential information and skills in order to maximize students' feelings of comfort, enjoyment, belonging, and autonomy (ibid., p. 22). In other words, for fear of upsetting students, progressive educators have ceased to challenge them.

Thus the debate between progressive and traditional educational philosophies comes down to differences in sincerely held opinions about what matters most in education. Progressive educators argue that education should cultivate values of exploration, social engagement, and self-confidence. Traditional and neo-traditional theorists argue that education should transmit to younger generations the knowledge and skills necessary for them to contribute to society through their freely chosen vocations. Presented thusly, we seem to be at an impasse: progressive and traditional theories represent two mutually exclusive ideas regarding the proper aims of education.

Perhaps, however, the impasse results from a false dichotomy. John Dewey, a prominent 20th century American philosopher, psychologist, and educational theorist, believed the progressivist-traditionalist dichotomy to be a false one and made impassioned and lucid arguments critiquing both sides of the debate. Despite the fact that Dewey's work continues to be widely discussed in education circles, his insights into our contemporary educational dilemmas have yet to be thoroughly appreciated by either side of the debate. Dewey, who figured at the forefront of the progressive education movement in the 1920s and 1930s, lived to see what he thought were dangerous departures from progressive ideals. In 1938 Dewey lamented trends in progressive education: "...many of the newer schools tend to make little or nothing of organized subject-matter of study; to proceed as if any form of direction or guidance by adults were an invasion of individual freedom, and as if the idea that education should be concerned with the present and future meant that acquaintance with the past has little or no role to play in education" (Dewey, 1997, p. 22). Presenting progressive education as merely reacting against and refusing to engage in the traditional form of pedagogy which sets the possession of knowledge as the aim of schooling, Dewey here accuses progressivists of failing to articulate a positive program. He then poses the question that serves as the bridge between the knowledge-based and attitudes-based philosophies of education: "We may reject knowledge of the past as an end of education and thereby only emphasize its importance as a means. When we do that we have a problem that is new in the story of education: How shall the young become acquainted with the past in such a way that the acquaintance is a potent agent in appreciation of the living present?" (ibid., p. 23).

Here Dewey means to criticize both the traditionalists and progressivists. The traditionalists have misunderstood the value of the knowledge of the past, and because of that misunderstanding, have sought to impose the past knowledge upon students. Traditionalists, he claims, reify the theories and concepts that have been handed down to us and see education as simply passing the inheritance unchanged to the next generation. Past theories and concepts, however, are "to a large extent the cultural product of societies that assumed the future would be much like the past, and yet [they are] used as educational food in a society where change is the rule, not the exception" (Dewey, 1997, p. 19). Taught as finished products, these ideas are something students must absorb without understanding their origins or development. As a result, students learn how to respond factually to questions constructed carefully by their teachers ("When was the Declaration of Independence signed?"), but not how to use those facts to better understand their world ("What role has the relative youth of the United States played in our contemporary foreign policy decisions?"). Conversely, in opposition to the mere recitation of hand-me-down facts, progressive educators failed in organizing subject matter at all for fear of imposing ready-made knowledge upon students. Dewey laments this overreaction, claiming that it is only when one falls into a false dichotomy ("the Either-Or philosophy") "that the knowledge and skill of the mature person has no directive value for the experience of the immature" (ibid., p. 21). Dewey agrees with the progressivists that education is properly conceived of as attaining knowledge and skills on the basis of experience. But he disagrees with

those progressivists who interpret such attainment to mean that we should discount all experiences other than the present subjective experiences of the students.

Dewey conceived the synthesis of these two seemingly disparate viewpoints as such: "We always live at the time we live and not at some other time, and only by extracting at each present time the full meaning of each present experience are we prepared for doing the same thing in the future. This is the only preparation which in the long run amounts to anything" (Dewey, 1997, p. 49). When Dewey wrote here of extracting the full meaning of the present, however, he did not mean to imply that "it doesn't make much difference what the present experience is as long as it is enjoyed" (ibid., p. 49). Rather, the full meaning of the present, properly conceived, includes the past and is directed toward the future. To fully understand the present moment, we would need to understand how the moment came about, what contributed to its being this way rather than that. We thus require a thorough understanding of the past, including all of those ideas and events that coalesced to bring this-here-now into being. We also require a recognition that this present moment will contribute to the quality (or lack thereof) of subsequent moments. Such insights serve as the basis of a maturing sense of responsibility: when a person comes to see that the sort of person she is today conditions the sort of person she can be tomorrow or a year from now, she may come to take responsibility for her own development. Likewise, the lessons of the past may illustrate the radical interdependence of human lives (if Socrates hadn't said what he said, Plato wouldn't have written the Republic, and Thomas Jefferson wouldn't have read it, and…). Such insights yield an even richer sense of responsibility (and perhaps even feelings of excitement!) for self-direction.

For Dewey, the aim of education is, quite simply, growth (Dewey, 1997, p. 36). Acknowledging that every human person changes continually so long as they remain alive (in fact, for Dewey, one might define life as "continuous, constant change"), he points out that we may properly distinguish between those changes which might serve to inhibit further change and those which support the ongoing process of development. The latter type of change is what Dewey means by growth: "from the standpoint of growth as education and education as growth the question is whether growth in this direction promotes or retards growth in general"[1] (ibid., p. 36). We conclude by posing this question of the contemporary middle-grades education system. What changes does the competitive, assessment-based climate of contemporary education effect in early adolescent students? Do those changes constitute growth?

Again, for Dewey, growth is not equivalent to change. We might think of growth as expansion—an opening rather than a constriction of possibilities. And such an expansive aim is important as we look at the practical goal of encouraging and supporting the growth of concrete individuals. That is, we must avoid the temptation to speak of growth in the abstract as it is the actual students—in their actual lives, within their actual contexts—to which educators and educational institutions attend. Taken thus concretely, the individual student's growth is from one type of life, to another type of life. As a sculptor must consider not only the figure she wishes to produce, but also the characteristics of the material she will work upon, so too must those endeavoring to guide a student toward a more expansive life consider the present life of the person whom they seek to educate.

Developmental psychology tells us much about the actual, present lives of early adolescents—their challenges, their concerns, and their desires. Taken together with research in motivational psychology, these developmental studies shed light on the social, pedagogical, and curricular means by which educators might best encourage growth in

[1] For instance, a person might change in such a way as to become a heroin addict. Although this is certainly "change," it is likely not "growth" in Dewey's sense, as heroin addiction inhibits the individual's ability to respond to perhaps pressing personal, social, and/or environmental situations.

middle-grades students. Specifically, our research shows that healthy early adolescent motivational development requires personal attention, inter-personal stability, opportunities for autonomous decision-making, and a diminishment of competition and social comparison.

A close look at the state of affairs in today's middle-grades schools shows a high-stakes environment in which extrinsic factors—grades, test scores, class standing, and the like—become the focus of students' educational lives. Research shows that schooling characterized by submission to the authority of teachers, tests, and/or subject-matter largely imposed from above "mismatches" with the developmental and motivational needs of early adolescence. From a Deweyan pedagogical perspective, such "mismatches" indicate a serious problem with regard to the cultivation of growth. The well-documented decline in academic engagement in early adolescence indicates that the change brought about by contemporary middle grades education does, indeed, as Dewey says, "[retard] growth in general" (Dewey, 1997, p. 36). That is, the change toward disengagement with one's educational experiences and one's intellectual heritage (passed down in the form of organized subject-matter) limits the possibilities for creative and intelligent responsibility for understanding who one is and choosing whom one seeks to become. In a basic sense, such disengagement reduces students' ability to appreciate and, when needed, redirect their own life, their community, and their world.

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Unpredicted Educational Uses of Video Games

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Abstract

Video games are often labeled by many critics as destructive to those who enjoy them. However, the games of today contain some commonly-overlooked merits. The work presented in this paper includes development and application of an evaluation system focusing on current video games that weren't meant to be educational. After evaluating over 100 video games, it was observed that there were large differences between the average scores of the various genres. Although the role-playing game genre received the highest marks, each game category had a game that presented the potential to learn or practice some knowledge or skill. Since almost every video game genre had at least one exception that scored either significantly higher or significantly lower than the genre's average score, a case is presented to consider each video game on an individual basis for its educational value. Nonetheless, nearly every video game assessed appears to have the potential to be used educationally or to be modified for educational use.

Introduction and Background

Educational games have been used for centuries to teach or enhance learning. Educational computer games have been around since some of the first personal computers. Recently, educational computer games have been of interest to companies for training purposes. Yet, there has been only one independent and long-term effectiveness study on commercially available educational computer games (Redfield, Gaither, and Redfield, 2008) of the over 1000 educational computer games as cataloged at http://www.wing-z2fly.com/GameSurvey (Redfield, Gaither, and Redfield, 2007). That study showed a significant increase in understanding of algebraic concepts over a 5 week period of playing Math Blaster Algebra. The study also showed no negative effects on grades or test scores for the students who played the game. These results give promise to educational

computer games and may even have implications for computer video games that were produced without intended educational outcomes. The survey of educational computer games in 2005 found no games for consoles that were intended to be educational. All the education games being produced at the time were for personal computers. So far, no one has looked systematically at existing computer games for unintended educational results. Likewise, no one has formally evaluated existing video games for unpredicted educational value. This study focuses on console and handheld games where there should be a great potential growth of educational purpose for video games.

This paper looks at popular video games, which are not characterized as educational, and suggests possible knowledge and skills that may be supported or enhanced by playing the games. A scoring process for educational potential was developed as a part of this investigation. The results of this scoring and the potential educational areas for over 100 games are presented in a table. The compiled data was reviewed and conclusions were drawn which suggest that each game should be considered on a case-by-case basis for educational purposes.

The work from this project began as a McNair Scholars Summer Research Program at St. Mary's University in San Antonio, Texas. Many students and other individuals participated in compiling the data on the video games. None of the participants complained about having to play the games and score them. In particular, Colin Wells and Neil Redfield from John Jay Science and Engineering Academy worked with the authors to evaluate games and organize some others to play and evaluate games.

Method of Analysis

A scoring method was needed to determine a video game's potential educational use so that different video games could be compared against one another. John Rice of the University of Northern Texas (2007) created a point system to rate video games for cognitive viability, called the Video Game Cognitive Viability Index, as shown in the following table where NPC means non-playable character and AI stands for artificial intelligence:

Game Name	**Y/N 1/0**
Requires users to assume a role in the game, rather than simply play.	
Offers meaningful interaction such as dialogue with NPCs.	
Has a storyline.	
Has a complex storyline with characters users care about.	
Offers simple puzzles.	
Has complex puzzles requiring effort to solve.	
Has complex puzzles requiring effort to solve.	
Allows multiple views or camera pans and the ability to zoom in and out.	
Allows different ways to complete the game.	
Simulates complex processes requiring adjustment of variables by users to obtain desired results or adjusting variables leads to different results.	
Allows interaction through use of avatars.	
Avatars are lifelike.	
Requires interaction with virtual elements within the game.	
Requires knowledge of game elements beyond mouse prompts, number entry (e.g., combining elements to create new tools, understanding complex jargon).	
Requires gathering of information in order to complete.	
Requires synthesis of knowledge in order to complete or successfully engage elements in the game.	

continued

Game Name	Y/N 1/0
Environment effectively replicates real world.	
NPCs display AI characteristics.	
NPCs display effective use of AI resulting in dynamic experiences for the user.	
Offers replay ability with varying results.	
Total Score:	

The breakdown of Rice's index based on the total score is as follows:

20	*Perfect score. Game displays highest elements of cognitive viability.*
15-19	*Upper-range. Game holds several positive characteristics lending itself to higher order thinking.*
14-18	*Mid-range. Game is probably acceptable for some higher order thinking opportunities.*
9-13	*Lower-range. Fewer opportunities for higher order thinking will take place in the game.*
0-8	*Little or no cognitive viability. Typical score range for arcade-style only games.*

While this rubric is adequate at scoring cognitive viability, this study focuses on educational viability, thus giving it a weak correlation using this scoring method. Therefore, a new rubric based on the Video Game Cognitive Viability Index was created called the "Video Game Educational Viability Index. Some of the point categories were kept in the new rubric, but many were removed or combined. The removed categories were:

- Offers meaningful interaction such as dialogue with NPCs,
- Has a complex storyline with characters users care about,
- Has complex puzzles requiring effort to solve,
- Uses three-dimensional graphics,
- Allows multiple views or camera pans and the ability to zoom in and out,
- Simulates complex processes requiring adjustment of variables by users to obtain desired results or adjusting variables leads to different results,
- Allows interaction through use of avatars,
- Avatars are lifelike,
- Requires interaction with virtual elements within the game,
- Requires knowledge of game elements beyond mouse prompts, number entry (e.g., combining elements to create new tools, understanding complex jargon),
- Environment effectively replicates real world,
- NPCs display AI characteristics, and
- NPCs display effective use of AI resulting in dynamic experiences for the user.

These categories were removed because they would not significantly impact educational viability. The new rubric's categories are as shown in the following table:

Video Game Educational Viablility Index	Y/N 1/0
Name of Game: Genre:	
The game requires that you assume a role.	
The game has a storyline.	
The game includes puzzles.	
The game employs environment manipulation.	
The game allows for multiple perspectives.	
The game requires gathering information.	
The game requires the player to increase his/her knowledge-base.	
The game requires creating and combining information.	
The game offers multiple playing paths with different results.	
The game connects to real issues.	
Total:	
Notes and potential educational uses:	

Each category that can earn a point for a game's educational viability is explained below. In general, if a game showed any evidence of the characteristic, a point was awarded. Each evaluator included a list of potential educational benefits with each game. Validation checks included having multiple evaluators survey the same game: if the scores were different, a closer look at the game was necessary.

The game requires that you assume a role. A game may be awarded this point if it either forces or allows the player to assume a role. In other words, rather than simply playing the game, the player is brought into the game by assuming a role within the game. For example, a game would earn this point if the player were allowed to choose to be a wizard, a hunter, or an archer. However, a game would not earn this point if the player were simply allowed to play. Most arcade shooters and simple fighting games would not earn this point. This point was in the original rubric and was kept in the new scoring system because allowing the player to assume a role facilitates a deeper understanding of the environment in which the player is immersed.

The game has a storyline. A game may be awarded this point if it has a story during game play. The game must provide the player details as to why they must do what is asked of them. Role playing games would earn this point, whereas racing games and space shooters might not. This point was also in the original rubric and was kept in the new scoring system because offering a reason as to why a player must do what is asked of him or her allows for deeper connection.

The game includes puzzles. A game may be awarded this point if it includes puzzles. Puzzle games will earn this point, as well as certain role playing games that require you to solve puzzles either to continue with the story or as side-story items. Racing games usually would not earn this point. This point was kept in the new rubric because puzzles are important in problem-solving skills and critical thinking.

The game employs environment manipulation. A game may be awarded this point if it allows the player to change the environment. In other words, if the player can change his or her in-game surroundings, the game would earn this point. Role playing games and adventure games that require the player to change the in-game environment to succeed would earn this point. Environment manipulation is important because it allows players to directly see how their interaction affects their surroundings.

The game allows for multiple perspectives. A game may be awarded this point if it offers the player alternate or opposing viewpoints. Some role playing games would earn this point along with games that allow you to choose a side (thus changing the story to be seen from the opposing point of view). This allows the player to learn to gain a better understanding of a situation by considering more than just one perspective.

The game requires gathering information. A game may be awarded this point if it requires the user to acquire information from within the game. Role playing games would usually earn this point along with some more advanced first-person shooters. For example, if a game requires you to find a password in an object in the game to unlock a door to continue, it would earn this point. This forces the player to pay attention to his or her in-game surroundings,

The game requires the player to increase his or her knowledge-base. A game may be awarded this point if it requires the player to increase his or her knowledge, whether it is in-game knowledge or real-world knowledge. Sports games with various rules and regulations would earn this point along with games that require you to learn a method of dealing with game objects or variables. This requirement is different from just gathering information because in order to increase the player's knowledge-base, he or she must not only gather information but must also apply it to what he or she is doing.

The game requires creating and combining information. A game may be awarded this point if the player must combine information to form new information or if the player must create new information himself or herself. For example, if players were given hints and must combine them to figure out how to proceed or if a player were allowed to create a new type of item based on choosing various properties, the game would be awarded this point. This forces the player to practice problem-solving skills and creativity.

The game offers multiple playing paths with different results. A game may be awarded this point if there are either multiple ways to complete the game or the player is presented with multiple paths that ultimately change major aspects of the game. For example, if a game presented the player with the choice to either save a party member or leave them behind and the player's decision impacted how the game ended, it would be awarded this point. This allows players to understand that their choices now may ultimately effect future big-picture outcomes.

The game connects to real issues. A game may be awarded this point if it connects to real-world issues. For example, sports games would earn this point because they are representative of real-world sports. Also, a game would earn this point if it included politics, sociological concepts, or resource management situations.

Evaluations

At the beginning of the study, IGN.com (2008a) reported there were over:

- 700 Playstation 3 games,
- 4,250 Playstation 2 games,
- 2750 Playstation games,
- 1000 Playstation Portable games,
- 1000 Nintendo Wii games,
- 900 Nintendo GameCube games,
- 1750 Nintendo DS games,
- 1550 Gameboy Advance games, and
- 1050 Xbox 360 games

available to U.S. consumers. There are over 10,000 video games to choose from. Since this number of games is an unmanageable number to analyze by the limited number of

individuals available, a way to select games for evaluation had to be employed. Video games were chosen based on top games lists on CNET.com (2008), IGN.com (2008b), and Gamespot.com (2008) retrieved on June 24th, 2008. Though not every game on the list was covered, an effort was made to assess as many games as possible. As of July 2008, a total of 104 video games were evaluated. The following table lists the games assessed using the Video Game Educational Viability Index:

Video Game Educational Viability

Platform	Game	Genre	Score	Benefit
DS	Clubhouse Games	Puzzle	4	Critical Thinking
DS	Diddy Kong Racing	Racing	3	Hand-eye Coordination
DS	Mario Kart DS	Racing	1	Hand-eye Coordination
DS	Mega Man ZX	Action	7	Reflexes
DS	Mega Man ZX - Advent	Action	7	Reflexes
DS	New Super Mario Bros.	Adventure	4	Reflexes
DS	Phoenix Wright - Justice for All	Adventure	6	Critical Thinking
DS	Phoenix Wright - Trials and Tribulations	Adventure	7	Critical Thinking
DS	Pokemon Diamond	RPG	9	Planning & Strategy
DS	Pokemon Pearl	RPG	8	Planning & Strategy
DS	Super Mario 64	Adventure	6	Reflexes
GBA	Golden Sun	RPG	9	Critical Thinking
GBA	Pokemon Emerald	RPG	8	Planning & Strategy
GBA	Pokemon Fire Red	RPG	8	Planning & Strategy
GBA	Pokemon Leaf Green	RPG	8	Planning & Strategy
GBA	Pokemon Ruby	RPG	8	Planning & Strategy
GBA	Pokemon Sapphire	RPG	8	Planning & Strategy
GCN	Metroid Prime	FPS	8	Reflexes
GCN	Metroid Prime 2: Echoes	FPS	8	Reflexes
PC	Doom 3	FPS	8	Reflexes
PC	Dungeon Seige 2	RPG	7	Planning & Strategy
PC	FlyFF	MMORPG	2	Planning & Strategy
PC	Halo 2	FPS	4	Reflexes
PC	Phantasy Star Online: Blue Burst	MMORPG	8	Resource Management
PC	Phantasy Star Universe	MMORPG	9	Resource Management
PC	Phantasy Star Universe: Ambition of the Illuminus	MMORPG	9	Resource Management
PC	Quake 4	FPS	4	Reflexes
PC	Risk: Global Domination	Strategy	5	Planning & Strategy
PC	Warcraft 3	Strategy	7	Planning & Strategy
PS2	Aero Elite: Combat Academy	Simulation	4	Planning & Strategy
PS2	Dance Dance Revolution Extreme 2	Music	2	Reflexes
PS2	Final Fantasy X	RPG	9	Planning & Strategy
PS2	Final Fantasy X-2	RPG	10	Planning & Strategy
PS2	Grand Theft Auto 3	Action	8	Problem Solving
PS2	Grand Theft Auto 3: San Andreas	Action	8	Problem Solving
PS2	Grand Theft Auto 3: Vice City	Action	8	Problem Solving
PS2	Harry Potter and the Chamber of Secrets	Adventure	7	Reflexes
PS2	Kingdom Hearts	RPG	6	Planning & Strategy
PS2	Kingdom Hearts 2	RPG	6	Planning & Strategy
PS2	Madden NFL 2004	Sports	1	Planning & Strategy
PS2	SOCOM II: US Navy SEALs	Action	8	Reflexes
PS2	The Sims 2	Simulation	6	Planning & Strategy
PS2	Zone of the Enders	Action	4	Reflexes
PS3	Flow	Simulation	2	Reflexes
PS3	Grand Theft Auto IV	Action	8	Problem Solving
PS3	GT Prologue	Racing	2	Hand-eye Coordination
PS3	The Orange Box	FPS	10	Critical Thinking
PS3	Warhawk	Action	2	Reflexes
PSP	Blokus Portable: Steambot Championship	Puzzle	2	Critical Thinking
PSP	Breath of Fire III	RPG	10	Resource Management
PSP	Chameleon	Puzzle	2	Critical Thinking
PSP	Crisis Core: Final Fantasy VII	RPG	9	Reflexes
PSP	Downstream Panic!	Puzzle	3	Critical Thinking
PSP	Flow	Simulation	2	Reflexes
PSP	Lumines	Puzzle	1	Critical Thinking

Continued

Platform	Game	Genre	Score	Benefit
PSP	Lumines II	Puzzle	1	Critical Thinking
PSP	Patapon	Rhythm	8	Critical Thinking
PSP	Puzzle Guzzle	Puzzle	1	Critical Thinking
PSP	Star Wars Battlefront II	Action	2	Reflexes
PSP	Wipeout Pulse	Racing	0	Hand-eye Coordination
PSP	Wipeout Pure	Racing	0	Hand-eye Coordination
PSX	Crash Banidcoot	Adventure	4	Reflexes
PSX	Final Fantasy IX	RPG	9	Resource Management
PSX	Final Fantasy Tactics	RPG	8	Planning & Strategy
PSX	Final Fantasy VII	RPG	9	Resource Management
PSX	Final Fantasy VIII	RPG	9	Resource Management
Wii	Excite Truck	Racing	1	Hand-eye Coordination
Wii	Mario Kart Wii	Racing	2	Hand-eye Coordination
Wii	Metal Slug Anthology	Action	4	Reflexes
Wii	Metroid Prime 3: Corruption	FPS	8	Hand-eye Coordination
Wii	Super Mario Galaxy	Adventure	6	Critical Thinking
Wii	Super Smash Brothers Brawl	Fighting	4	Reflexes
Wii VC	Breath of Fire II	RPG	8	Resource Management
Wii VC	Bubble Bobble	Adventure	4	Reflexes
Wii VC	Contra III: The Alien Wars	Action	5	Reflexes
Wii VC	Cruis'n USA	Racing	1	Hand-eye Coordination
Wii VC	Donkey Kong	Action	1	Reflexes
Wii VC	Donkey Kong Country	Adventure	4	Reflexes
Wii VC	Donkey Kong Country 2: Diddy Kong's Quest	Adventure	4	Reflexes
Wii VC	Donkey Kong Country 3: Dixie Kong's Double Trouble	Adventure	4	Reflexes
Wii VC	Double Dragon	Action	3	Reflexes
Wii VC	Dr. Robotnik's Mean Bean Machine	Puzzle	1	Critical Thinking
Wii VC	Ecco the Dolphin	Adventure	2	Reflexes
Wii VC	F-Zero	Racing	0	Hand-eye Coordination
Wii VC	Harvest Moon	Simulation	6	Planning & Strategy
Wii VC	Kirby's Adventure	Adventure	3	Reflexes
Wii VC	Kirby's Dream Course	Sports	0	Planning & Strategy
Wii VC	Mario Kart 64	Racing	1	Hand-eye Coordination
Wii VC	Metal Slug	Action	3	Reflexes
Wii VC	Paper Mario	RPG	8	Reflexes
Wii VC	Pokemon Snap	Simulation	5	Reflexes
Wii VC	Sonic 3D Blast	Adventure	4	Reflexes
Wii VC	Star Fox 64	Shooter	5	Reflexes
Wii VC	Super Mario Bros.	Adventure	3	Reflexes
Wii VC	Super Mario Bros. 2	Adventure	4	Reflexes
Wii VC	Super Mario Bros. 3	Adventure	4	Reflexes
Wii VC	Super Mario World	Adventure	4	Reflexes
Wii VC	Super Metroid	Adventure	7	Reflexes
Wii VC	Super R-Type	Shooter	0	Reflexes
Wii VC	The Legend of Zelda: A Link To The Past	Adventure	7	Reflexes
Wii VC	The Legend of Zelda: Ocarina of Time	Adventure	8	Reflexes
Xbox 360	Bioshock	FPS	9	Reflexes
Xbox 360	Civil War: A Nation Divided	FPS	4	Reflexes
Xbox 360	Halo 3	FPS	4	Reflexes

Please note the following abbreviations: FPS (First-Person Shooter), RPG (Role-Playing Game), and MMORPG (Massively-Multiplayer Online RPG).

The chart was arranged by platform in order to facilitate browsing.

Analysis & Results

Over 100 video games were reviewed and scored using the Video Game Educational Viability Index. The following is a count and percentage of games by video game system (percents are rounded to two decimal places):

- 35 (33.65%) Nintendo Wii games (some are played on the Wii Virtual Console),
- 14 (13.46%) Playstation 2 games,
- 13 (12.50%) Playstation Portable games,
- 11 (10.58%) Nintendo DS games,
- 10 (9.62%) PC games,
- 6 (5.77%) Gameboy Advance games,
- 5 (4.81%) Playstation 3 games,
- 5 (4.81%) Playstation games,
- 3 (2.88%) Xbox 360 games, and
- 2 (1.92%) GameCube games.

The count and percentage of video game genres is as follows (percents were rounded to two decimal places):

- 21 (20.19%) adventure games,
- 21 (20.19%) role playing games,
- 15 (14.42%) action games,
- 10 (9.62%) first-person shooter games,
- 10 (9.62%) racing games,
- 8 (7.69%) puzzle games,
- 6 (5.77%) simulation games,
- 4 (3.85%) massively-multiplayer online role playing games,
- 2 (1.92%) shooter games,
- 2 (1.92%) sports games,
- 2 (1.92%) strategy games,
- 1 (0.96%) fighting game,
- 1 (0.96%) music game, and
- 1 (0.96%) rhythm game.

The following is the average score of the various game categories:

- 8.29 points role playing games,
- 8.00 points rhythm games,
- 7.00 points massively-multiplayer online role playing games,
- 6.70 points first-person shooter games,
- 6.00 points strategy games,
- 5.20 points action games,
- 4.86 points adventure games,
- 4.17 points simulation games,
- 4.00 points fighting games,
- 2.50 points shooter games,
- 2.00 points music games,
- 1.38 points puzzle games,
- 0.70 points racing games, and
- 0.50 points sports games.

The order of genre average scores arranged from lowest to highest are sports, racing, puzzle, music, shooter, fighting, simulation, adventure, action, strategy, first person shooter, massively multiplayer online role playing, rhythm, and role playing game. Role playing games score the highest on the scale with an average score of 8.29/10.00 points

and sports games score the lowest with an average score of 0.50/10.00 points. Role playing games probably scored higher because they involve many different types of interactions.

Each game evaluated using the Video Game Educational Viability Index had at least one potential benefit. The most prominent benefits along with the count and percentage of said benefits were as follows (percents were rounded to two decimal places):

- 46 (44.23%) reflexes,
- 21 (20.19%) planning & strategy,
- 14 (13.46%) critical thinking,
- 11 (10.58%) hand-eye coordination,
- 8 (7.69%) resource management, and
- 4 (3.85%) problem solving.

The benefits of hand-eye coordination and reflexes are represented as different categories because hand-eye coordination consists of controlling game objects in a representative manner while reflexes involve reacting to game stimuli. Other benefits presented in some of the evaluated games include reading, communication, dexterity, and logic exercise.

Conclusion

Although role playing games scored the highest in this study, there are counterexample games in many categories that could show higher potential educational uses than the average score. For example, the puzzle genre was one of the lowest scoring of the study, but most any type of puzzle can be considered exercise for your brain and works logic and critical thinking skills. Another counterexample: a racing game could enhance hand-eye coordination and other driver-related skills.

It appears that role playing games have the most potential for educational use. Role playing games may be the best candidates for educational modification as well. The most common benefits of the games assessed in this study were reflexes, planning & strategy, and critical thinking.

What can be concluded from this study is that there are many factors in video games that are difficult to quantify into a definitive scoring system that determines educational value. While the scoring system employed is a good indication of educational viability, it does not necessarily determine whether a game has educational value or not. Therefore, video games and their potential for educational use should be considered on a case-by-case basis.

Future Work

Potential future work would include expanding the collected data to see if it changes conclusions made in the study thus far and performing an educational-effectiveness study of one or more of these non-educational games.

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High Throughput Screening to Identify Inhibitors of *Candida albicans* Biofilm Formation

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Abstract

Candida albicans is a common opportunistic pathogen of humans and the main cause of candidiasis, one of the most frequent fungal infections carrying high morbidity and mortality rates, particularly in immunosuppressed patients. Typically, these infections are associated with the formation of biofilms on both host tissues and implanted biomaterials. Biofilms are defined as complex microbial communities attached to a surface and encased in an exopolymeric matrix. Importantly, cells within biofilms are resistant to conventional antifungal therapy. The objective of this project is to screen libraries of small molecules for potential compounds displaying inhibitory effects against biofilm formation. The different libraries contain hundreds of compounds that are prescreened to have drug-like properties. To screen these libraries, an in-house developed 96-well microtiter plate-based method was used to form C. albicans SC5314 biofilms in the presence of the compounds. A total of 2320 compounds from 3 different libraries were screened. Of these, 51 compounds have been found to have inhibitory effects against C. albicans biofilm formation. These "hits" represent promising molecules for the development of new antifungal agents that are urgently needed. Future studies in the laboratory are aimed at further characterizing these small molecule inhibitors and their mechanisms of action.

Introduction

Candida albicans is a fungus that coexists with bacteria within our bodies as part of our commensal microbiota. Its presence usually does not affect a person's health unless they have a defective immune system; in which case candidiasis can occur. Candida infection can be as superficial (i.e. a vaginal yeast infection) or can become life threatening if fungal cells enter into the bloodstream and disseminate to distal organs. Given the increasing numbers of individuals taking immunosuppressive therapy, antibiotic therapy

and use of intravenous catheters Candida infections are becoming more common. Mortality rates are nearly 50% in those who are infected; therefore finding better treatments has become a high priority.

The morphology of *C. albicans* is an important determinant in the pathogenesis of these infections. *C. albicans* exists mainly in three morphogenetic states (yeast, hyphae, and pseudohyphae), and is able to reversibly switch between the yeast and filamentous (hyphal and pseudohyphal) forms depending on the environmental conditions in which it is growing. The yeast form resembles the budding-yeast, Saccharomyces cerevisiae. The pseudohyphal form consists of elongated yeast cells that remain attached at conjunctions of adjacent cells; whereas true hyphae are elongated tubes with parallel sides (15, 27, 30, 39). The hyphal form of *C. albicans* is often found at sites of tissue invasion and is thought to differentially express cell-wall proteins involved with adhesion to human tissues to facilitate invasion. Although the hyphal form of *C. albicans* is commonly regarded as more virulent than the yeast form, emerging data indicate that both morphologies play distinct roles during infection, with the yeast form mostly associated with dissemination through the blood stream and the filamentous forms mostly involved in penetration, biofilm formation and tissue damage (5, 30). In addition, the ability to switch morphologies may also assist the pathogen by enhancing its resistance to host defenses and by modulating and evading the host immune responses during infection.

Several microorganisms exist not as singular cells but as a community of cells forming biofilms. Biofilms are defined as structured microbial ecosystems that are attached to a surface and encased in a matrix of exopolymeric material. Characteristics of biofilms include surface attachment, structural heterogeneity, genetic diversity, complex community interactions, and an extracellular matrix of polymeric substances (EPS). Generally biofilms are found attached to hard surfaces in aqueous solutions, and are encased in EPS which provides protection, as well as, facilitates communication. As part of a biofilm, microbes exhibit increased resistance to antimicrobial agents and host immune defenses. Biofilms are of clinical importance, considering that 65-80% of all human microbial infections involve biofilm formation (8, 10, 11, 12, 13, 16).

C. albicans remains the fungal species most commonly associated with biofilm formation. In fact, the increase in Candida infections in the last few decades has paralleled the increase use of medical implant devices. Devices such as stents, shunts, prostheses, implants, endotracheal tubes, pacemakers and various types of catheters, have been shown to support colonization and biofilm formation by *C. albicans* (22). To form a biofilm, the yeast cells must first adhere to the surface. This attachment of *C. albicans* to the surface is mediated by both non-specific, such as surface hydrophobicity and electrostatic forces, as well as, specific adhesions on the fungal cell surface. The adhesions recognize and bind to ligands such as serum proteins (fibronectin and fibrinogen) and salivary factors on surfaces (6). Upon attachment, individual yeast cells undergo cell division, proliferation, and biofilm development. Attachment of the yeast cells is followed by germ tube formation within 3-6 hours, and after 24-48 hours the fully mature *C. albicans* biofilms consist of dense network of yeast, hyphae, and pseudohyphae encased in an expolymeric matrix. Mature biofilms show a complex three-dimensional structure and extensive spatial heterogeneity and range in thickness from 25 to more than 450 micrometers (3, 7, 8, 18, 19, 23, 32, 33). This complex biofilm structure allows for influx of nutrients, disposal of waste products, as well as, the establishment of micro-niches throughout the biofilm (35).

Two of the main consequences of biofilm formation with important clinical repercussions are the resistance to antifungals and host immune responses. These are multifactorial phenomena involving different mechanisms including: effects of the biofilm matrix; decreased growth rate and nutrient limitation; expression of resistance genes, particularly

those encoding efflux pumps; and the presence of persister cells (cells that once antifungal concentrations drop become active and reconstitute the biofilm) (1, 2, 4, 20, 24-6, 29, 34). Once Candida biofilms are formed on these medical devices, therapeutic interventions rarely clear the infection, and surgical removal of the device is often required.

As mentioned above, cells within biofilm display high levels of resistance to most antifungal agents. Thus, it is clear that novel strategies and better drugs are needed to prevent *C. albicans* biofilm formation. High-throughput screening (HTS) is the process of testing a large number of diverse chemical structures against disease targets to identify potential "hits" that inhibit the process of interest. Compared to traditional drug screening methods, HTS is characterized by its simplicity, rapidness, low cost, and high efficiency. In these techniques, large diverse libraries of small bioactive molecules can be tested in in vitro assays using HTS to identify those molecules that affect a particular biological process of interest (17, 9, 14). These approaches differ significantly from rational drug design in that they require no detailed structural information about the target molecule, but rather allow the selection of active structures through sampling large numbers of structurally diverse small molecules (21). Because of the conceptual similarities to genetic strategies, these small molecule approaches have also been referred to as "chemical genetics" (28, 38) (they are also referred to as "phenotype-based approaches"). One further advantage of using small molecules to investigate basic biological mechanisms in pathogenic microorganisms such as *C. albicans* is that it may simultaneously yield promising leads for the development of new antifungal drugs. Here, we have used HTS to screen several libraries of small compounds for inhibitors of *C. albicans* biofilm formation.

Materials and Methods

Strain and Media

The *C. albicans* yeast strain used was wild-type strain SC5314. Cells were stored at -70°C as glycerol stocks and propagated by streaking a loopful of cells onto yeast peptone dextrose (YPD) agar (1% [wt/vol] yeast extract, 2% [wt/vol] peptone, 2% [wt/vol] dextrose) and incubating overnight at 37°C. Flasks (150 ml) containing 20 ml of YPD liquid media were then inoculated with a loopful of cells from YPD agar plates and grown overnight in an orbital shaker (150 – 180 rpm) at 30°C. Under these conditions, *C. albicans* grows as budding-yeast (31).

Standardizing Inocula

C. albicans cells were harvested from overnight YPD cultures (growing in the yeast form) and washed twice in sterile phosphate buffered saline (PBS; 10 mM phosphate buffer, 2.7 mM potassium chloride, 137 mM sodium chloride [pH 7.4] [Sigma, St. Louis, MO]) by centrifugation at 3000g. The cells were then resuspended in RPMI. One hundred fold dilutions of the suspended cells were prepared and counted using a haemocytometer on a bright field microscope. Following count, the desired cell concentrations, 1.0 x 106 cells/ml, were prepared in RPMI (31).

Libraries of Small Molecules

We used three libraries of small molecules, Natural products, Structural diversity and Challenge sets obtained from the National Cancer Institute (NCI). The compounds in the libraries are provided as 10 mM solutions. An initial 1:100 dilution for each compound was prepared by pipetting 2 µl of this concentrated solution into 198 µl of PBS using the wells of pre-sterilized, polystyrene, round-bottomed, 96-well microtiter plates (Corning Incorporated, Corning, NY). 5 µl of this dilution will go into individual wells of 96-well

microtiter plates in which *C. albicans* biofilms are formed (see below, biofilm formation). The final concentration at which the compounds are tested is 5 µM.

Biofilm Formation

C. albicans biofilms are formed on commercially available pre-sterilized, polystyrene, flat-bottomed, 96-well microtiter plates (Corning Incorporated, Corning, NY). Biofilms are formed by pipetting standardized cell suspensions (95 µl of the 1.0 x 106 cells/ml) into wells in columns 1-11 of the corresponding microtiter plates. For each plate, wells in column 1 contain 5 µl of PBS, these serve as positive controls (biofilms formed in the absence of compound). Wells in columns 2-11 contain 5 µl of each individually diluted compound per well. The 12th column of wells on the plate should remain empty; these will be the negative background controls. The microtiter plate is covered with its lid, sealed with parafilm and incubated for 24 hours at 37° for biofilm formation. After biofilm formation the RPMI medium is flicked off into a sink and blotted with paper towels. Planktonic and non-adherent cells are removed by thoroughly washing the biofilms two times in sterile PBS (200 µl per well). Residual PBS is removed by blotting as well (36).

Visual Analysis of Biofilms

Following the incubation period, biofilms formed on the bottom of the wells are visible by the naked eye, simply by looking at the underside of the microtiter plate. A brightfield microscope or an inverted microscope with a 20X or 40X objective is sufficient enough to examine morphological details of the formed biofilms. Images can be captured if microscope can connect to a digital camera or video equipment (36).

Colorimetric Metabolic Assay (XTT Reduction Assay)

This assay relies on the reduction of XTT by metabolically active cells to yield a water-soluble formazan colored product that can be measured in a microtiter plate reader. To prepare XTT, a XTT (0.5 g/L) /PBS solution is filter sterilized through a 0.22 µm-pore size filter, aliquoted into 10 ml working volumes, and stored at -70°C. Tubes of the XTT solution are wrapped in aluminum foil to prevent light penetration during preparation. Menadione (Sigma, St. Louis, MO) is prepared as a 10 mM stock solution in 100% acetone, and stored at -70°C. Prior to each assay, an aliquot of stock XTT is thawed and 3.5 µl of mendione is added.

75 µl of the XTT/menadione solution is added to each pre-washed biofilm and to negative control wells. The plates are then covered in aluminum foil and incubated in the dark for up to 2 hours at 37°. If XTT is effectively reduced by live yeast cells, the original clear solution turns orange. After incubation, plates are then read in a microtiter plate reader (Benchmark Microplate Reader, BioRad, Hercules, CA) at 490nm (36).

Statistical analyses

All experiments were done with duplicates of each plate so each compound is tested twice in two different plates. Average optical density (OD) values of XTT readings were calculated from replicate wells corresponding to the same compound, after background was eliminated by subtracting the OD of the blank wells. The inhibitory effect of the compounds was expressed as the percentage of the optical density (OD) in treated wells compared to that of control (untreated) wells. The inhibitory effect of each compound treatment as compared to control wells was assessed by using the Student's t test. $p < 0.05$ was considered statistically significant. The analyses were performed using GraphPad Prism version 4.0 for Windows (GraphPad Software, San Diego, CA) (31).

Results and Discussion

Bioactive molecules ("hits") were identified as those compounds leading to a reduction of ≥ 50% in *C. albicans* biofilm formation compared to controls, as measured by the XTT colorimetric assay. The results were further split into five degrees of inhibition, from highest to lowest. The first was a range was a 90-100% inhibition of biofilm growth. The second was a range of 80-90%. The third was 70-80%. The fourth was 60-70%. The final range was from 50-60%.

Natural Products Set

A total of 240 compounds in the Natural products set were tested. There were 16 hits. The hit rate for the Natural products set was 7%. There was one hit in the first range of inhibition. There were four hits each in the second through fourth range. There were three hits in the fifth range.

Structural Diversity Set

A total of 2,000 compounds were tested for the Structural diversity set. Of these, there were 19 hits, for a hit rate of 0.95%. There were five hits in the first range of inhibition. There were seven hits in the second range. There were four hits in the third range. No hits were within the fourth range. There were three hits in the last range.

Challenge Set

The Challenge set comprises of 80 compounds. There were 16 hits. The hit rate for the Challenge set was 20%. The first range contained 8 hits. There were two hits in the second range. There were three hits in the third range. There was one hit in the fourth and fifth range.

Conclusions

High throughput screening of small molecule libraries provides a valid approach to study complex processes of biological relevance that affect *C. albicans* pathogenesis. In this case we have used these techniques to study biofilm formation an important trait associated with *C. albicans* virulence.

The 96-well microtiter plate model for *C. albicans* biofilm formation developed in our lab provides an easy, highly reproducible, robust, and relatively inexpensive method for performing a high-throughput screen of small molecule compounds with potential inhibitory effects on *C. albicans* biofilm formation.

Natural products are normally more active than chemically synthesized compounds, so the higher hit rate observed for this set compared to the Structural Diversity set was not unexpected. Still, the hit rate observed for compounds in the Structural Diversity set was higher than normal (0.95% versus approximately 0.3% expected). The Challenge set contains products that have been pre-selected on the basis of their cytotoxicity, thus the high hit rate observed for compounds in this library may be due to non-specific killing rather than to a more specific effect on biofilm formation.

Further studies are necessary to complete the screening phase of these studies, as well as to further characterize these small molecule inhibitors and their mechanisms of action.

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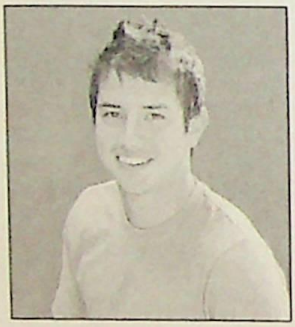
Initial Evaluation of the Science Teacher and Researcher (STAR) Program



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Abstract

The California State University (CSU) system continues to rank below average in the production of high quality math and science teachers. To attract and retain K-12 educators with a better knowledge of subject matter and investigative skills, the Science Teacher and Researcher Program (STAR) program links scientific research experiences with teaching. Through private funding and leadership from CSU, STAR provides science majors interested in teaching, an eight-week internship at a national lab. Participants engage in science research to help better understand their dual role as a teacher and researcher in society. This segment of the evaluation study consists of analyzing demographic data, observing lab sites, and conducting interviews to determine ways the program can improve, while measuring its' success. The group of 19 females and 11 males range in age from 20 to 57 with career levels ranging from undergraduates to full-time teachers. Preliminary findings indicate that a majority stated the program provided a wider scope of knowledge and deeper understanding of specific fields. Clarifying concepts and explaining real world applications to their students are examples the participants stated as benefits from their research experience. Participants learned that scientists don't arrive at one right answer but rather use multiple paths during investigations. Identified areas for improvement include better alignment between research projects and participant's field of study and more communication between mentors and interns about the project, also program developers need to make explicit connections between the nature of science and research experiences.

Introduction

The California State University (CSU) system remains the largest in the country, with over 450,000 students and 23 campuses. Approximately 60% of the teachers credentialed, or 10% of the nation's teachers, are certified by the CSU organization.[4] A recent

finding from the National Assessment of Educational Progress indicated that almost half of California's eighth grade students scored "below basic" in science and math.[2] Among national figures, California's students' performance taken in 2005 rates among the poorest in the US in knowledge and aptitude in mathematics and science, according to data taken from Trends in International Mathematics and Science Study (TIMSS).[3] The CSU Board of Trustees made excellent preparation of teachers a top priority, setting the goal of doubling the current amount of science and math teachers by 2009-2010 from 750 to 1,500.[1] Nearly one-third of physical science and math teachers considered unprepared or teaching out of their content area.[5] This lack in educational training and knowledge ultimately results in poor scientific preparation of students.

To address the quality and shortage of teachers, CSU initiated the Science Teacher and Researcher program (STAR) in partnership with the Center for Excellence in Science and Mathematics Education (CESaME), the Department of Energy's national research laboratories (Stanford Linear Accelerator Center (SLAC), Lawrence Livermore National Lab (LLNL), and Lawrence Berkeley National Lab (LBNL)), and the NASA Ames research center. Providing the opportunity for science teachers to work in a summer internship at one of these facilities is essential to promote science and math teacher retention in California, while identifying their dual role within society. By establishing learning communities of science majors interested in teaching K-12 students, CSU hopes to generate a better understanding of what it means to be a teacher while providing participants with a chance to experience high quality research. Their research activities will be accompanied by seminars on inquiry-based science teaching and learning in order to connect the doing of science to the teaching of science. CSU believes this is a promising solution to the crisis and therefore has selected 30 high-achieving science majors in 2008 to participate in the STAR program.

Star Program Components

The Science Teacher and Researcher program gives science majors the opportunity to experience research at a national laboratory through an eight week paid internship. Attracting undergraduate science majors to teaching careers, the STAR program enables future science teachers to gain first-hand experience in applied research settings. Another goal is to cultivate an increased interest and esteem toward teaching science as a profession. CSU also intends to improve the personal investigative skills of each person along with an increase in their understanding of the nature of science. Anchoring preservice and early career teachers in a scientific community, they will better understand what it means to be a scientist and to foster inquiry-based science teaching and learning techniques within the classroom. Reducing science teacher attrition while expanding outreach programs between national labs, universities, and K-12 schools, CSU is optimistic that this will further encourage experiments, field trips, and guest scientists to become more involved in education.

The first week is mainly devoted to making sure the participants are comfortable with their lab setting and ensuring that they are well versed in the safety procedures of the lab. The first week also includes an orientation on what takes place at the lab with guest speakers who discuss the research they are currently involved in, in order for the participants to acquire a sense of what it is like to be a scientist. During the first week they will also meet with their mentor to get a more thorough view of their lab and the projects they will be assigned to.

Every Thursday a two hour workshop focuses on inquiry-based learning and how to implement the scientific process into a classroom. The workshops illustrate the importance of involving students in the daily lessons that help them better understand the

content.

My primary role in the project is to assist with the evaluation of the STAR program. The assessment focuses on the overall quality of the STAR program, its effectiveness, and the extent to which the participants expanded their content knowledge. Using different analytical instruments, I communicated my ideas and views to help assess and monitor the performance of the program while providing continuous feedback to my mentor and other program leaders. The instruments and information used consist of application, recommendations, transcripts, direct observations, surveys, and interviews.

The pilot STAR program conducted in the summer of 2007 consisted of sixteen CSU students who performed research at the Lawrence Livermore National Laboratory. Preliminary evaluation results indicated that the mentor scientists uniformly felt the participating students contributed to their labs and that there were substantial benefits for the students. More than 90 percent of the participants stated that:

- They learned a significant amount about the scientific field form the research experience.
- Their research experience and mentor helped them understand how to conduct scientific research.
- The research opportunity taught them a range of things that will help them as a science teacher.
- They anticipate benefiting further and would like to participate again the next summer.

Evaluation Outcomes

From the results of the pilot, this evaluation will focus on the STAR programs ability to:

- Attract and Retain STEM Majors in Teaching Careers
- Increase Disciplinary and Teaching Knowledge

Improve understanding of the Nature of Science Research

Develop Positive Attitudes toward Science Teaching and Scientific Research

To measure the programs' success at attracting and retaining STEM majors in teaching careers we will analyze transcripts, review letters of recommendation, interview participants, and examine the participants' responses to essay questions and surveys. We plan to track the number of undergraduates who apply and complete a CSU credential program. We will also measure how many credential candidates apply and receive a teaching position as well as following the progress of beginning teachers.

Though it often proves difficult to measure content knowledge, we plan to use transcripts (course level, grade, etc) and letters of recommendation to initially describe the breadth and depth of course work for each participant. Identifying changes in disciplinary knowledge through independent interviews and questionnaires about the growth of the participant through the research experience will be conducted with the mentor and participant. Journal entries will also be implemented to acquire changes in the participants' view of a scientist and teacher, and any links between the two.

The program anticipates the participants will share their improved understanding of the nature of science with others, from these avenues, and will measure changes with pre and post concept maps, the Knowledge of the Nature of Science questionnaire, and journal entries. To gauge their involvement in the research and growth of investigative skills we will use a questionnaire for the mentor, observation of the participants at work,

and the grading of their poster, which arranges their summer research, using a rubric.

Research indicates the changes in participants' beliefs, attitudes, and interests are powerful measures of a successful program. In hopes to construct links between careers in science research and teaching, an examination of the participants' journal entries, pre and post interviews, and the Science Teaching Efficacy Belief Instrument pre-service survey (STEBI) will measure such transformation.

Based on pre to post intervention comparisons on a number of measures for the 30 participants in the 2008 STAR program, interviews and more intensive evaluation measures with a sub sample of the participants will be gathered. Ultimately, CSU hopes to attract and retain qualified science teachers to help increase the science learning in K-12 schools. To reduce science teacher attrition, the STAR program will immerse the participants into the scientific community while broadening their understanding of the nature of science and research. By developing positive attitudes toward science teaching and research, CSU predicts the STAR program will cultivate disciplinary and teaching knowledge, focusing on inquiry based teaching and learning.

This report will only discuss the procedures and preliminary findings for the review of the applications and the mid program observations and interviews. The rest of the evaluation will be finished after the completion of my internship.

Procedures

I reviewed the entrance applications and recorded relevant data on an excel sheet about why the participant appreciates teaching, their fit within the program, and any previous research experience. This data was grouped by research site, and then further sorted by new and returning participants from the pilot program. Qualifying information on a spreadsheet allowed age, career level (undergraduate, credential, or teacher), CSU campus attending, GPA, and major, for use in a comprehensive view of all participants.

Next, I took the data from the spreadsheet and gathered the participants' info based solely on their age group; a further separation of gender, age, and education was recorded. The evaluation team then arranged and discussed a list of questions from which to ask the participants during their interviews. Deciding what order to place them, determining how to arrange them in a way to keep the participants talking, and how to document the interview process (see interview protocol).

My mentor and I observed the participants from SLAC and NASA while at their labs noting their work area, projects, and communication with others. Asking questions that would give us a better understanding of the daily tasks they encountered, how they felt about science, and their summer experience. We recorded the 14 participants' descriptions about their research, on a hand held digital recording device, along with their thoughts about science and teaching. I reviewed the interviews to examine responses, determine patterns, review them a second time to verify answers, and to select quotes to illustrate key findings.

One challenge during the interview process was participants' responses would come before the questions were asked, or their responses that would refer back to previously mentioned responses. Determining how to improve the program so that the national laboratory and participants get the most out of the experience remains a vital focus within the project.

Preliminary Results

The participant sample consisted of 11 males and 19 females (see Graph 1). Participants ranged in age from 20 to 57 (see Graph 2). The participants also varied in their paths to becoming teachers. Thirteen members of the group were undergraduates, with

nine of the participants working on their teacher credential, one Master's student, and three who are practicing teachers (see Graph 3). Table 1 shows the distribution of the STAR participants by gender, age, and career level. The STAR interns conducted research at four locations: SLAC, LLNL, LBNL, and NASA. See Graph 4 for distribution of the participants at each of the locations.

Preliminary results from the SLAC and NASA observation interviews were surprisingly consistent. The following findings summarize the responses to observation interviews conducted with 14 of the STAR participants.

Interest in Science and Teaching

Most of the participants replied that they became interested in science because they are inquisitive about the world, and how science constantly evolves to help with new questions and discoveries, leading to answers and a sense of accomplishment. One participant stated, "I like figuring things out, I like to know things about everything around me, and science gives you the tools to figure this stuff out." (Id 11).

They became interested in teaching to: (1) improve the sad state of science education in the community, (2) enjoy working with kids and being able to actively change their perception of the world, (3) and the influence previous teachers had on their career. This was best articulated by the response, "If you don't teach people what's going on then you can't continue to advance the knowledge of the world basically, people need to step on other peoples' shoulder…to further our overall knowledge of what's going on, so you need to teach people what you know so you can take it a step further" (Id 1).

Nature of Science

Overall the participants lacked a comprehensive understanding of the nature of science. When pressed for a response to the question, "What does the Nature of Science mean to you?", four stated the need to ask a good question, while another four referred to the constant nuisance of authorization (national, state, lab, etc.), and two others mentioned how it was more creative and mellow of an atmosphere than they had thought.

Work of Scientists

Almost half of the participants noted that throughout their project they learned that scientists need to be patient and open to changes in their research. Most of the work is trial and error and there is no known answer; therefore they must work with perseverance. They must be innovative and flexible enough to overcome numerous obstacles such as funding, equipment design, and bureaucracy. One participant stated, "It gives me a clearer idea [about the work of scientists] because I have never been involved in the actual science, but how they publish their papers, and what they do with their conference and how they organize their time. It has allowed me a window to see what's going on because I have been interested in science for decades but I have never been on the inside like this before." (Id 8)

Lessons Learned

Over 75% of the STAR participants mentioned that prior to this internship they lacked exposure to particular instrumentations, software, and systems that they have now mastered and feel comfortable using. Some examples listed by the participants include: UV BIZ spectrometer, Astro-biology, DNA staining probes, and realigning magneto-tactic bacteria.

More than half stated that this program has given them a wider scope of knowledge and deeper understanding of specific fields, overall enriching their research experience.

Most participants indicated a feeling of increased credibility because of their work in a national laboratory. Involvement in the modern areas of science with a new perspective on cutting edge ideas and procedures stimulated their scientific and teaching interests, educating them on the role of a scientist and teacher. Being able to clarify concepts and show real world applications to their students are examples the participants stated as benefits that resulted from their research experience. The participants also learned that scientists don't usually arrive at one right answer but rather use multiple paths during the investigation to reach their conclusion. As explained by one participant this has impacts as future science teachers, stating, "I wont be expecting from students that this is the only way to work, there can be a different way to solve a problem and if you do it a different way it doesn't mean its wrong" (Id 10)

Challenges

When questioned about challenges they faced in their labs, the responses varied with close to 50% indicating the complexity of gathering large databases with undefined constraints, and then questioning its' importance. Another portion mentioned three key challenges related to the first week: (1) becoming accustomed to the work environment, (2) learning new software and terminology, and (3) initial interactions with their mentors. Many of the participants from the NASA site indicated they were unclear about the program goals after orientation and they felt the orientation was directed toward another group.

Program Improvements

Close to half the students were concerned with their placement within the program. The most frequent issue described by the participants included poor matches between the research project and their field of study. This point is illustrated by a participant's comment, "more correlation between major and the project they are working on..." (Id 13) For others the research experience was more computer-based than laboratory based, which resulted in some disappointment in their placement demonstrated by statements like, "its research but I don't feel like its science research" (Id 7). Participants recommended that the program "try and get STAR mentors to get more acquainted with students before program starts..." (Id 14).

Lessons Learned

Initial findings indicate that the program has run successfully. All the participants seemed pleased that they were given a chance to be a part of a National Laboratory discovering how real science happens. More than 85% found their particular contribution to the research interesting as it helped expand their minds to the limitless possibilities of science, and everyone showed interested in returning for the program next year.

The project's originality leaves room for continual growth and improvement. One important area for improvement includes the need for better placement within the program, ensuring that the participants receive the site that is most convenient for them, but more importantly reinforcing project fit within their field of study or interest. This will reduce anxiety, and ease the first get-together of participants and mentors so they can work toward a similar goal of enhancing productivity. To enhance communication between the mentors and STAR participants would be major step to increasing effectiveness.

The preliminary findings indicate a general lack of understanding about the nature of science. The program needs to explicitly emphasize and reinforce these concepts. An effective method for accomplishing this would consist of more in depth discussion of how their research connects to the nature of science.

their research connects to the nature of science.

Conclusion

Initial evaluation results have indicated that the participants are content with the program and hope to be chosen for next summer's internships. The high quality presentations during their poster sessions identified a broad range of science areas, and confirmed that the CSU students became familiar with the nature of research and successfully engaged in the processes. Ranging from a conceptual understanding of the research issues explored, to a deeper appreciation of scientific inquiry and an understanding of sophisticated equipment used in scientific research, the STAR participants gained a wealth of knowledge to pass on to future generations.

A definitive conclusion would still be premature at this point; however the data seems to advocate that the Science Teacher and Researcher program has a constructive impression on securing the interests of science majors in teaching. With the long-term evaluation of the program, a design that focuses on the research experience and the dual role of scientist and educator, the continuation of the STAR program will offer an opportunity to participate in paid summer sessions for future years, persistently extending relationships while providing opportunities through other federal agencies and programs including NASA and Industry Initiatives for Science and Math Education (IISME). Anticipating the program will collaborate with other national labs, NASA sites, and industry partners in California to expand the program to 100 participants by the summer of 2010.

Acknowledgements

This work was supported by the National Aeronautics and Space Administration at Ames, as well as Stanford Linear Accelerator Center. I would like to take this opportunity to express the utmost appreciation to my mentor Dr. Susan Schultz. She has contributed greatly to an unforgettable summer through her continual support and inspiration in working with me, going above and beyond what I expected. I would also like to thank Jan Mokros, and Farah Rahbar for their assistance with various aspects of the project. Additionally, I would like to thank the Department of Energy, SLAC, and the Communications Offices for the facilitation of such a wonderful program and allowing me to be a part of everything.

Figure 1: Thursday Workshop Schedule

Week 2	Placements and Goal Setting	Ames
Week 3	Creating a classroom lab	Ames
Week 4	Science Writing	Ames
Week 5	Saturday Workshop	Ames
Week 6	Getting a job as a teacher	Ames
Week 7	Teacher in a science setting	SLAC
Week 8	Wrap-up	Ames

Figure 2: Purpose of STAR Program

Attract and Retain STEM Majors in Teaching Careers

- What are STAR participants' future goals?
- How far along are they on their teaching career?
- How successful is the program in attracting and retaining participants with a wide range of backgrounds? What facilitates this success?

Develop Disciplinary and Teaching Knowledge

- What's the depth of the participants' disciplinary knowledge?
- What is their understanding of the nature and role of science and teaching science?

Understand the Nature of Science Research

- To what extent have the participants understanding of the nature of science developed as well as their investigative skills?
- In what ways have the participants developed an understanding of various types of inquiry-based learning?

Develop Positive Attitudes toward Science Teaching and Scientific Research

- How attractive is the teaching profession to them?
- To what extent do participants view themselves as members of the scientific as well as teaching community?
- How do participants perceive the value and relevance of the summer internship in terms of preparing them to become science teachers?

Figure 3

STAR Program Observation Protocol
Summer 2008

Explain purpose of visit to STAR participant

Name of Participant _____
Research Site _____
Date _____ Time _____

Ensure digital recorder is working and ask participant's permission to use the recorder during the interview portion of the visit. Participant's Permission: Yes or No

Observation
Location of work/research area _____

Describe what the participant is doing when you arrive.

_____
_____
_____

Figure 3 continued

Ensure digital recorder is working and ask participant's permission to use the recorder during the interview portion of the visit. Participant's Permission: Yes or No

Observation
Location of work/research area _____

Describe what the participant is doing when you arrive.

_____
_____
_____

Briefly describe work area (i.e. research lab, office space, etc.). Determine if this is the usual location for participant's internship or whether there is another location. If there is another location, ask participant to describe that area.

_____
_____

Identify any colleagues who work with the participant on a regular basis (i.e. mentor, other interns, graduate students, post docs, etc.).

_____
_____

STAR Program Observation Interview
Summer 2008

Explain to the participant that we are gathering information to learn about their specific research experience and their current thinking about the internship with the ultimate goal of improving the STAR program. Encourage them to be honest in their responses.

1. What interests you about science? About teaching?

2. Briefly describe your research project.

3. What is your role and contribution to this research project?

4. What have you learned about the work of scientists during your internship?

5. What research content, techniques, and designs have you learned?

6. What have been the challenges?

7. What has surprised you about conducting this research?

8. Based on your current research, what are you thoughts about hoe science happens/the nature of science/or the process of science?

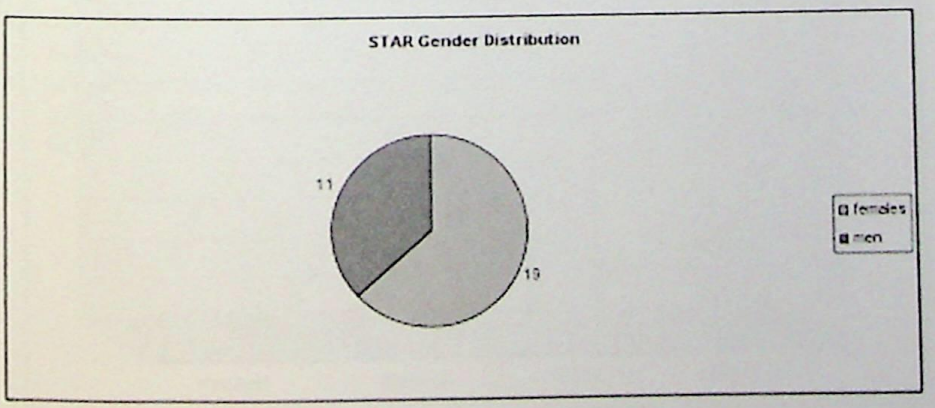
9. What have you learned that will benefit you as a scientist? As a science teacher?

10. How has what you learned stimulated your scientific and teaching interests?

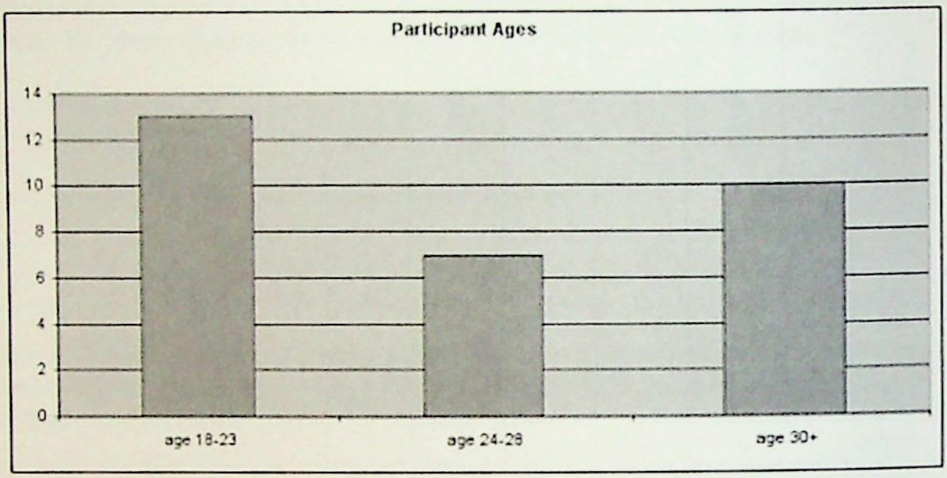
Table 1: Number of Participants sorted by gender/age/career level

Age Cohort	Undergraduate	Credential	Master's	Teacher
Ages 18-23				
Female	7	0	1	0
Males	5	0	0	0
Ages 24-28				
Female	2	0	4	0
Males	0	0	1	0
Ages 30+				
Female	3	0	1	1
Males	0	1	2	2

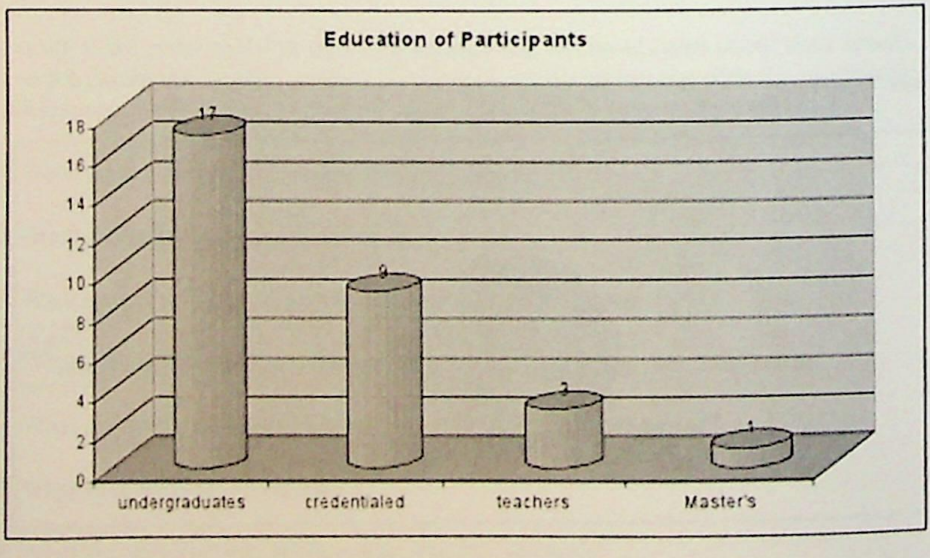
Graph 1



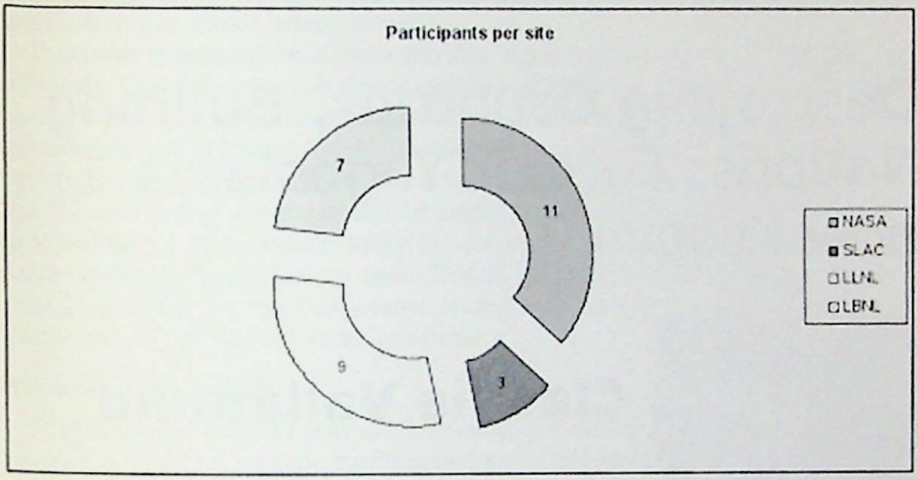
Graph 2



Graph 3



Graph 4



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Destroying Countries, Building Nations: Former Yugoslavia 1- now Kosovo 7

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Abstract

How did Kosovo become the newest country when it was denied independence only a decade ago? Yugoslavia itself was formed in 1918. It remained unified until Tito's death in 1980, despite including over 20 ethnic groups. In January 1991, Slovenia and Croatia declared their independence, which shattered the country into five distinct parts through years of civil wars (Bosnia-Herzegovina, Serbia-Montenegro, and Macedonia). The 1995 Dayton Accords were to stop this fragmentation and solidify the borders of the now five nations. Yet Kosovo that remained under Serb control renewed its fight for independence. With ninety percent Albanians and ten percent Serbs, Kosovo stood ethnically divided. In response to the creation of the Kosovo Liberation Army, Milosevic stepped up his policy of ethnic cleansing. However, close involvement and monitoring by the international community resulted in the bombing of Serbia in March of 1999, yet Kosovo was given autonomy only, not independence. So how did Kosovo finally receive international support for independence on February 17th, 2008? How did Kosovo gain independence so easily when so many others such as Tibet or Chechnya continue to fight for it? Did NATO, the OSCE, and the EU lay the foundations for independence? Did its contested genocide influence this outcome? This paper explores the last decade of developments in Kosovo to assess what helped it gain its sovereignty at a time when the international community prefers autonomy to independence as the outcome of most ethnic conflicts.

Introduction

In fewer than ten years, Kosovar Albanians achieved what has eluded many other ethnic groups: their own state with independence. Once a province and now a nation in central Europe, situated with Serbia on its northern and eastern borders, Kosovo had been refused the opportunity for independence twice before so the odds were seriously against them. In 1995, The Dayton Peace Accords attempted to settle the disputes over the

borders within the Former Yugoslavia. Unfortunately, Kosovo remained under the rule of Serbia and suffered much because of it. Then, again in 1999, following NATO's intervention, Kosovo was denied independence.

This paper examines how Kosovo was able to gain its independence, following years of struggle. Could the genocide that caused the international community to intervene have laid the foundations for its independence? Were NATO and the EU the driving forces by their involvement in leading the way to independence? How was Kosovo able to gain support for independence in fewer than ten years after being forced to settle for autonomy? The next section surveys briefly the historical developments that lead to the break up of the Former Yugoslavia following the end of the Cold War. This break- up granted Serbia the chance to rule Kosovo again. This led for the opportunity of development by major international groups. Furthermore, these groups were the reason why Kosovo was restructured and recognized for independence.

Historical Developments

Slightly smaller than the state of Connecticut, Kosovo's frontiers have shifted over the centuries. After being ruled by the Ottoman Empire for more than five centuries, Kosovo was regained by Serbia in 1912. In 1945, following World War II, the government of the Socialist Federal Republic of Yugoslavia, under the rule of Josip Tito, made Kosovo an autonomous province within the constituent Republic of Serbia. After about thirty years and following the lobbies of many Kosovo Albanians for a more flexible and independent form of autonomy, Kosovo was finally granted a more or less equal opportunity as a republic. In 1974, Kosovo was granted autonomy under the new Yugoslav constitution.

As part of the Former Yugoslavia from 1945 to 1992, Kosovo was ruled by Josip Broz Tito until his death in 1980. It was after his death that Kosovo began to experiencing ethnic cleansing. Without Tito's tight rein over the Former Yugoslavia, ethnic and nationalist movements began to flare. Despite the recognition under autonomy given to Kosovo, the Albanians grew weary for independence and as a result became more nationalist, responding through riots. Serbs in Kosovo began to complain of mistreatment, and Serb nationalist leader Milosevic took advantage of the situation to gain the support of more Serbs through their votes. The Serbs fought back, and in 1987 a mob of Kosovo Serbs protested against the Albanian administration. Slobodan Milosevic had been head of the Serbian Communist Party since 1987, in which he had challenged the Yugoslav federal government, (Malcolm,1999 341-344). As a firm supporter of Serbian control of the autonomous provinces of Kosovo as well as Vojvodina, and of Yugoslavia as a whole, Milosevic was determined to oppress the Albanian people. In 1988, Milosevic replaced three party leaders in Kosovo, (Judah 2008). Slobodan Milosevic also decided to break off the agreement on Communist neutrality when he decided to take sides with the Serbian people of Kosovo, who claimed that the ethnic Albanians had mistreated them through their nationalist riots. Milosevic took advantage of these yearnings to win support among Serbian voters. In 1991, Kosovo Albanian leaders responded by organizing a referendum that declared Kosovo free from Serbia. Gaining support of other Serbian nationalists, Milosevic got rid of the Serbian leader, Ivan Stambolic and a year later, Kosovo was annexed to Serbia, (Encyclopedia Farlex 2008). Milosevic and those who endorsed him formed the Anti-bureaucratic revolution whose main goal was to remove the more neutral Communist leaders. In the provinces of Kosovo and Vojvodina, as well as in the Republic of Montenegro, Milosevic replaced leaders with his loyalists and in little time gained the control of not only Serbia but also took precedence in Slovenia, Croatia, and Macedonia concerning the political issues of Yugoslavia.

Amidst the ethnic tensions increased by this harsh rule, the Former Yugoslavia slowly

began to break away. First in June of 1991 Slovenia and Croatia declared their independence. Slovenia, composed of ninety percent ethnic Slovenians, was fortunate enough to break away with only minor fighting in 10 shorts days. Croatia, lengthened its time to independence to four years after serious civil war. The leading factor had to do with the fact that one-tenth of the population in Croatia was Serbian . Following Croatia, Bosnia and Herzegovina and Macedonia had referendum that led them to declare their independence in 1992. Due to the ethnic diversity in Bosnia that included Croats and Bosnian Muslims who opposed the Bosnian Serbs, a war erupted, leading to hundreds of thousands of deaths. The war lasted over four years and came to an end when The Dayton Peace Accord came into effect. Negotiated in Dayton, Ohio and signed in Paris in 1995, the treaty established an international peacekeeping force in Bosnia- Herzegovina. It stated that the country would remain a single state within its existing borders. The compromise formed a Muslim- Croat Federation as well as a Serb Republic. The Dayton Peace Accord was signed by the United States, Serbia, Bosnia & Herzegovina, and Croatia. Its intentions never included Kosovo and this lead to the establishment of the Kosovo Liberation Army, (Encyclopedia Farlex 2008).

The Dayton Peace Agreement only seemed to have brought temporary peace to the region. As Bosnia settled, Kosovo seemed to have exploded into more ethnic violence in the Balkans. Kosovo's 2.5 million ethnic Albanian majority was being repressed at the time by Belgrade and controlled by the small Serb minority living there. The ethnic Albanians remained furious that Milosevic had stripped Kosovo of its autonomous status under the 1974 Yugoslav Constitution in 1990 and because the Dayton Accords ignored their plight completely. Following the recognition of Bosnia under the Dayton Peace Accords, Kosovar nationalists were persuaded that maybe an increase in its militancy would gain international support. Regardless, the Dayton Accords made no mention of Kosovo but only stated that "an 'outer wall' of sanctions will remain in place until Serbia addresses a number of areas of concern, including Kosovo." (New York Times, 1999). But what kept Kosovo from gaining what it was striving for and had been refused? Milosevic would not give up Kosovo and he refused to acknowledge the fact that the Albanians were mistreated anyway.

Under these circumstances, was Kosovo ever to be granted independence? The disadvantage here for Kosovo was that Milosevic opposed economic reform as well as any political development that would have provided Kosovo sovereignty. As mentioned, the Dayton Peace Accords were signed in 1995 and brought developments in Bosnia, Croatia, and Serbia to an end. Constitutional and governmental reforms were structured more rigorously as a result. In December of 1995, the NATO-led IFOR (Implementation Force) became responsible for implementing military aspects of the agreement. This led to a more powerful Serbia and Milosevic began to repress opposition in Kosovo, . (Encyclopedia Farlex 2008). The Dayton Accords did not include Kosovo and removed hope for the independence it longed for. Some Kosovar Albanians were angered that their situation was not addressed in the Accords and responded by creating the Kosovo Liberation Army (KLA).

The Kosovo Liberation Army (KLA) developed under the idea that if it provoked open conflict with Serbia, the West would eventually find its way to intervene. This separatist movement claims to have attacked Serbia with bombs and would target Serbian police. In March 1998, the KLA gunned down Serbian policeman, (Mertus, 1999 308-309) and Milosevic struck back through a harsh burning of homes and murders of Albanians. From 1997 to 1999, patterns of human rights violations by Serbian forces increased as they launched an offensive against the KLA. Milosevic responded by attacking villages and town where KLA members took refuge. Something needed to be done.

For the meantime, Ibrahim Rugova, who was the leader of Kosovo at the time, needed to find a political solution. His method of "passive resistance," did not suffice for independence and some of the people moved to support the violence from the KLA. On September of 1998, the North Atlantic Treaty Organization, (NATO) gave Milosevic a final request to "halt the crackdown on Kosovo Albanians," (BBC News Online 2008). Milosevic ignored NATO 's orders which led NATO to launch air strikes for 78 days until Belgrade yielded on June of 1999. Milosevic agreed to withdraw his troops from Kosovo, (BBC News Online 2008). Calling off air strikes, (NATO), who had been delegated the power to assure security in the region through the Dayton Accord, later took interim administration of Kosovo under the United Nations (UNMIK).

NATO Involvement

NATO became involved with Kosovo in a way that had never been seen by the organization before. The UN had delegated power to NATO in 1995 to assure 'regional security' as defined by the Dayton Accords. Following reports in January 1999 of the escalation of the violence and clear patterns of human rights abuses as in Rakac, the international community, including NATO, put pressure on Serbia to end the conflict. Representatives of the Serbian government met in France in February of 1999 with representatives of the KLA and when the negotiations failed because of the lack of compromises from the Serbian side, NATO decided to move up to the next phase with the bombing, (Encyclopedia Farlex 2008). Beginning on March 24, 1999, NATO jets, under the command of General Clark, began to bomb Serbia. They were to continue bombing until Milosevic accepted the autonomy compromise. For the first time in history both the United States and its European allies intervened to prevent what could have been another genocide in the Balkans. This mission was called 'Operation Allied Force' by William S. Cohen, Secretary of Defense, who explained to the Senate Armed Services Committee, that the main military objective was to "degrade and damage the military and security structure that President Milosevic (Yugoslav President) ha[d] used to depopulate and destroy the Albanian majority in Kosovo," (Operation Allied Force, 2008). NATO planned on pursuing its air strikes until President Milosevic made sure to do fulfill several requirements. Prerequisites included a verifiable stop to all of the military action, hence an end to violence and repression. NATO also required for Milosevic to guarantee the withdrawal of military from Kosovo, as well as police and paramilitary forces. One of NATO's goals in its mission was to lead Milosevic to agree to the "stationing in Kosovo of an international military presence." (Daalder 2000) Milosevic was to also "agree to the unconditional and safe return of all refugees and displaced persons and unhindered access to them by humanitarian aid organizations," (Daalder 2000). Last but not least, NATO would require Milosevic to provide credible assurance of his willingness to want to work "on the basis of the Rambouillet Accords in the establishment of a political framework agreement for Kosovo in conformity with international law and the Charter of the United Nations," (Operation Allied Force, June 1999).

The United Nations Mission in Kosovo, known as UNMIK has played a major role in the development of Kosovo since. After the 1999 bombings by NATO, the United Nations was given the task of governing Kosovo through its Interim Administration Mission in Kosovo, with the mandate of providing Kosovo with "a transitional administration while establishing and overseeing the development of provisional democratic self-governing institutions to ensure conditions for a peaceful and normal life for all inhabitants in Kosovo," (UNMIK 2008) With the United Nations Security Council Resolution 1244, UNMIK provided an international presence in Kosovo. Under this resolution and through this last decade, UNMIK guided Kosovo through its formation of Provisional Institutions

of Self Government (PISG) which gave Kosovo more responsibility through its governmental affairs. Starting off as the commanders in the executive goals of the PISG, UNMIK has slowly stepped aside and has instead demoted itself to simply providing support, as well as acting as a monitoring unit of the local institutions. Aside from this particular form of aide, what UNMIK has provided financially, has definitely been the key factor of support which has led to Kosovo's independence. Most recently, looking at numbers, Kosovo received US$239,889,800 from 2005-2006, (UNMIK 2008). From 2006-2007, the budget for Kosovo provided by UNMIK was an estimated US$217,962,000. Finally, from June 2007-June 2008, the UNMIK budget was at US$210,676,800. For a country the size of Kentucky, the international support provided for the developments were huge. They have provided Kosovo with a more structured government, an increase of law enforcement capability and a stronger judicial system, all of which were successful in making independence for Kosovo more likely.

In order for the money to be used efficiently and for its cause, the United Nations decided to employ its people in Kosovo and many still remain today. As of January 2008, not including the amount of police, the number of international UN staff located in Kosovo was 462, local UN staff was that of 1892, and 125 United Nations Volunteers, (UNMIK, 2008)! In coordination with NATO, The Organization of Security in Europe (OSCE), employed a total of 999 staff, calculating to 283 International and 716 local. With the amount of monetary aide provided and having the support of the people working under it to help the Kosovars, several standards were taken into consideration for more efficiency. These standards were developed in 2002-2003 as eight fields. Each of these fields were seen as priorities and were maintained in order to develop a fairer and more tolerant society. These eight fields include the fields of: Functioning democratic institutions, Rule of Law, Freedom of Movement, Sustainable returns (and the rights of communities and their members), Economy, Property Rights (cultural heritage), Pristina-Belgrade dialogue, Kosovo Protection Corps (KPC), (UNMIK, 2008). This agenda contained 109 goals for Kosovo that were to be finalized and implemented through the 'Kosovo Standards Implementation Plan' by March of 2004.

One of the central elements to helping Kosovo transition was establishing and training its own police force. UNMIK police, alongside with the Kosovo Police Service, has expanded successfully. In 2001, more than 3,300 police officers from more than 50 countries took part in UNMIK. UNMIK police as of Feb of 2008, had reduced to a presence of 1499 police officers from only three countries. The Kosovo Police Service (KPS) has proved worthy of respect and continues to seek the support and trust of the Kosovars. The KPS now holds the command of all 33 police stations and five out of the six Regional Police Headquarters across Kosovo! Now, UNMIK's role simply consists of simply supporting and monitoring, taking the task to act as the overall supervisory authority of the UNMIK Police Commissioner. For the mean time, there are 7,124 KPS officers (6160 male/ 964 female) (6082 Albanians, 746 Serbs, 414 other minorities), (UNMIK, 2007). Together, these two entities have successfully investigated 182,983 cases ranging from activities of beat patrols and traffic checks, to investigations into much more serious crimes

Funds, support and police units are not all that has granted Kosovo opportunity to move on to the road of independence. The UNMIK Department of Justice, (DOJ), has definitely provided justice to an extent not seen before. Its successes in prosecuting crimes of corruption, terrorism, and war abuses have laid a strong foundation. The DOJ has extended its responsibilities to a transition of local institutions such as the Ministry of Justice and the Kosovo Judicial Council. The DOJ has established the Kosovo Special Prosecutors Office to allow local prosecutors to "Take on more serious cases in the future,

including corruption, organized crime and crimes against public office," (UNMIK 2008). Currently there are 302 local judges and 83 local prosecutors. Due to the budget of 2008, additional positions have been made to hopefully increase to 392 judges and 92 prosecutors under UNMIK. As far as international judges, there are 15 as well as 11 prosecutors, (UNMIK Online June 2008). NATO and the UN were not the only intergovernmental organizations to invest time, personnel, and financial support, both the EU and the OSCE were also important actors in transitioning Kosovo to independence.

EU & OSCE Involvement

Aside from UNMIK, the European Union (EU) acted as one of the largest donors for Kosovo. In 2006, the EU donated 30% of the total amount committed, (UNMIK ONLINE July 2008). The EU has contributed to Kosovo's development through three major forms. These include the reform of police and judiciary, the reform of public administration and rural development, (EC Europa/ Enlargement June 2008). Under the project executing its reform of police and judiciary, the EU has completed the 1.3 million Euro construction of three border police station buildings. These buildings are located at border crossings with Albania and the main goal of the EU is to improve the overall border management in Kosovo. (EC Europa/ Enlargement June 2008). The EU hopes to make a smooth transition from international to local police and develop the management of borders by local authorities trained in Kosovo. Second, the EU is providing support for The Assembly of Kosovo. Organizing its parliament can influence a better developed country. The development of liberal democratic institutions is essential for the transition to independent rule, (Dahl, 1990; and Snyder, 2000). The EU has provided 3.5 million Euros to help Kosovo learn how to become both participant and productive through its cooperation with civil society. European Parliaments have taken part of the project and derive from France, Germany, Belgium and Slovenia, (EC Europa Enlargement 2008). Last but not least, the EU has supplied for agro-processing and Industrial revitalization, also known as FAIR. This meant that the EU participates and invests on providing substantial aid for the least developed areas in order to fight unemployment. FAIR provides financial and technical support to entrepreneurs and grants for businesses are also getting advice in areas that range from finance and marketing to production and management. (EC Europa Enlargement 2008).

The Organization for Security and Co-operation in Europe (OSCE) completes the list of forces to Kosovo's development which have lead to the independence it was granted this past February of 2008. Established by the OSCE Permanent Council on the 1st of July 1999, the OSCE Mission in Kosovo forms a component of UNMIK and is responsible for institution and democracy building as well as for providing human rights and the rule of law, (OSCE May 2008). Under democracy-building, the OSCE established the judicial system in 1999 and took the role to identifying judges and providing logistical support. Monitoring the system in compliance with international human rights standards has helped protect Kosovo of its rights and interests within all communities and vulnerable groups, (UNMIK Online Aug 2008). Other important factors contributing to democracy building include the development of the Kosovo Chamber of Advocates (KCA), the legal aid system, and the Kosovo Bar Exam (which from 2001-2006 guided 1,500 lawyers to prepare for the exam through a comprehensive preparation programme, (UNMIK Online Aug 2008). Through its Human Rights role, the OSCE has established various institutions that support the legal community in which two have transitioned and are succeeding to full local ownership. These are the Kosovo Judicial Institute, which trains judges and prosecutors, and the Ombudsperson's Office, which investigates complaints that deal with the violation of human rights as well as the abuse of authority by officials, (UNMIK On-

line Aug 2008). Last but not least, the media has also been structured because public understanding is just as important. In 1999, OSCE established the public service broadcaster, Radio Television Kosovo (RTK), (UNMIK Online Aug 2008). In order to develop media and professional standards, the Temporary Media Commissioner (TMC) was created and was followed by the Independent Media Commission (IMC), (UNMIK Online Aug 2008).

International Acknowledgment: Pros and Cons

Having benefited from many investments and volunteers for such an extended period of time, Kosovo escalated and was recognized for its independence on February 16th, 2008. For the countries that helped in this success, recognizing Kosovo and acknowledging the fact that it is free from Serbia comes with ease and no commitments. 43 UN member states have recognized it and within these are the United States, France, the United Kingdom, Japan, Germany and Canada, to name a few. Note that these countries are not suffering annexed pieces of land syndromes or claims of separatism by smaller ethnic groups and therefore the opportunity cost is not very high. Unfortunately, for countries like China and Russia, as well as Serbia, the recognition of Kosovo as independent is unacceptable. For Serbia, the recognition is tough because Kosovo was part of it and Serbia claimed that it had tremendous historical significance. China has not recognized it yet because it has to deal with Tibet and would not mix in what it continued to call internal affairs of Serbia. Russia renewed fight over the status of Chechnya challenges its border integrity. Other countries against Kosovo's independence include Spain, Brazil and Cuba.

Conclusion

This paper explained that while Kosovo was denied its earlier autonomy in 1989 by Milosevic, it was then denied twice more its independence. In 1995, by the Dayton Accords de facto, left Kosovo as a part of Serbia. Then in 1999, following the bombings it was again denied independence and this time put under UNIMIK governance. Slowly, the UN, NATO, the OSCE, and the EU started treating Kosovo like an independent country. In its report on UNMIK Online, Giorgio Mamberto, the head of the European Commission Laison Office in Kosovo, (2006) states that the European Commission published its annual progress report on Kosovo and that for the first time since it "is published as a separate document and not as an annex to the report of Serbia and Montenegro, (UNMIK Online 2008). Each organization invested tremendous levels of funds in building Kosovo's new police force, justice system, and other institutional arrangements that are crucial for the survival of sovereign countries. Would this path to independence be possible for other places that struggle for independence such as Tibet or Chechnya? Well, the prospects are grim since neither regions benefit from the kind of regional organizations found in Europe. Furthermore, both seek independence from major world powers, who possess nuclear weapons. Therefore, it is unlikely at this time that other struggles for independence will follow the route taken by Kosovo.

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Employer Attitude toward Immigration and Immigration Policy

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Abstract

Immigration policies have been devised to control the influx of illegal immigrants that come into the United States, and to respond to the number of undocumented immigrants already within the country. The goals of these laws are rarely accomplished. Despite the 1986 Immigration and Reform Control Act (IRCA), the number of people entering the United States without proper documentation has continued to grow and it is estimated that presently approximately 12 million people reside in the US illegally. At present, there is considerable debate and disagreement about the current immigration policy and it is important to consider why different people have different opinions. Building from the assumption that people who rely on immigrant labor tend to view immigration more positively, this study uses a survey to examine the hypothesis that Hispanic business leaders are more permissive in their attitudes toward immigration and immigration policy than non-Hispanic business leaders within the San Antonio area.

Introduction

The United States is a country of immigrants who have helped build this country into a prosperous world power. People from all over the world try to reach this land in hope of finding the "American Dream." However, there is concern that there are many people entering the country illegally. It is estimated that 12 million immigrants are in the country illegally (Martin 2008). Local and national newspapers report on the various raids on employers that have taken place across the country in an attempt to deport workers who are in the country illegally. The *Washington Post* reported that at least one-third of the immigration judges being appointed by the Justice Department since 2004 lacked knowledge and experience with immigration law. These judges deport thousands of im-

migrants who have no right to an attorney and a limited right to appeal. Some politicians have proposed the idea of deporting all 12 million and yet others have tried to seek some type of amnesty to provide identification to all these people. There is no agreement as to what should be done.

One reason there is so little agreement is because of different attitudes people and politicians have about immigrants and immigration policy. A reason for these different attitudes consists of the gathering of inaccurate or incomplete information, misconceptions, and negative stereotypes. If more people are educated about the issue, agreement over immigration reform is more likely to occur. Public attitudes toward any issue are important, including immigration policy.

Research will help alleviate some of the confusion on the topic and offer reasonable options for dealing with illegal immigrants and immigration policy. Considering why and how attitudes arise is also essential to understanding how to confront these issues while reducing tension among the public. The research presented will shed light on attitudes of those who help build and manage our economy, business owners and general managers. It will be proposed that owners and general managers of businesses that rely more heavily on immigrant labor have more favorable attitudes toward immigrants and support more permissive immigration policy, especially if they are Hispanic-owned businesses as opposed to non-Hispanic business owners.

Literature Review

From building a wall across the Mexican border, to an amnesty program which would allow many to gain a place within American society, so many strongly opposing views have led to conflict within the chambers of Congress. Seven amnesties have been passed by the United States Congress since 1986. In 1986 the Immigration and Reform Control Act (IRCA) helped pave the way to legalization by granting 2.7 million immigrants amnesties. Despite IRCA, 12 million undocumented immigrants are estimated to be currently in the country, and between 2.2 million to 4 million are estimated to come in illegally annually. Immigration in general continued growing with each individual that came in either legally or illegally. Legislation has to be structured in a manner that respects the human rights of immigrants, the security of the nation at large, and the health of the economy. Previous laws, to a certain extent, have been based on assumptions and misconceptions of immigrants. Laws must be made in a more realistic sense by taking into account issues pertaining to immigration and not based on misconceptions. The literature offered on the topic will shed light on some of the most recent research conducted concerning the source of negative attitudes and their causes.

Disagreements arise because of differing attitudes which are developed and supported by the various sources from which information is derived. Much research has been done to identify the link between immigration and attitudes. Thomas Espenshade (1995) has determined through his studies that people see immigrants as competition; the consequences resulting led to the notion that immigrants were taking jobs from natives to unfairly using social services, such as healthcare and education. Espenshade sets up these attitudes within a specific period after 1875 in which restrictionist rules were first introduced within the United States. During this time there was a commonly held negative sentiment toward immigrants, being that they were seen as having a harmful impact on American society. America became more liberal and accepting of immigration after World War II. Tolerant attitudes were reported to have lasted throughout much of the 1950's and 1960's, but were replaced by "neo-restrictionists" in the 1970's (Espenshade, pp. 201-02). The following results help define the period Espenshade refers to

as neo-restrictionist. A Roper poll taken in 1990 demonstrated that three-fourths of the American public wanted no increase in immigration and one-half felt that the numbers should be lowered. In 1993, New York Times/CBS conducted a similar study and found that two-thirds of the respondents wanted a reduction in immigration, while 6% wanted it to increase (Espenshade, p. 202). The findings of Espenshade when testing five previous hypotheses found that these attitudes toward illegal immigration were developed by respondents based on their evaluations of tangible costs and benefits to themselves. The study also found that older respondents tended to see immigration in more negative terms, as opposed to educated Hispanics, who were optimistic about illegal immigration. Espenshade's research on attitude concluded that the root cause of negative sentiment was economic insecurity, which could only lead to negative ethnic relations. Adrian Pantoja (2006) through his study supported Espenshade's findings. He demonstrated that socio-demographics such as being Latino was positively associated with supporting reductions within border patrol enforcement and the passing of more flexible policy. Surprisingly, African- Americans, assumed to be one of the most affected minority groups, demonstrated a positive sentiment toward the issue of immigration. To a certain extent, the study was able to conclude that both Latinos and African Americans were more supportive of immigration than Anglos (Pantoja, p. 526).

Differing attitudes can be linked to many factors, but one of the most important to the American public is the economic impact of immigration on wages and job competition. The leading reason for people to migrate from their home countries is hope of finding a decent paying job and thus a better life. There is no way to track all of those who come into country illegally since they remain in hiding to avoid being deported or incarcerated. Enrico Marcelli (2005) focuses on two studies conducted before 1994 that analyzed the economic impact of immigration. Both studies used the U.S. census data. The first was conducted by the University of Texas in the late 1980's. The study analyzed whether there was any impact caused by immigration on the white US-born wages. It concluded that there was only a small negative effect. Proceeding to the Southwest area of the country, they found that illegal immigrants had a contrary effect to their first findings since immigrants actually had a small positive impact on wages (Marcelli, p. 47).

The second study was conducted by the University of Toledo in the early 1990's also using the U.S. census bureau data to verify whether illegal immigration had an impact on the unemployment rates among minorities or not. Their findings suggested an inverse relationship in that illegal immigrants tended to cluster in areas with low employment rates within minority groups. This means that immigrants were only in areas where there were sufficient jobs. Other studies conducted by the university demonstrated that immigrants tend to take on less desirable jobs only after socially integrated groups of workers move into more desirable positions (Marcelli, p. 47).

David Card (2005) takes a different approach by focusing on the extent to which immigrants harm the labor market opportunities of less-skilled natives. Card utilized various mathematical equations in order to measure the effect of unskilled immigrants on wages. His findings led him to conclude that immigrants had reduced native wages by a small percentage. The missing data within Card's research should demonstrate the demand for drop-outs versus graduates due to the fact that the negative effects are suspected to only impact low-skilled workers' wages. Card argues that though this subject can be refuted either way, the fact is that fewer than forty percent of immigrants will ever be able to earn as much as the average native due to their lack of education (Card, p. 20). Another reason why immigrants' affect on wages is diminished is that they are highly mobile and tend to return to their home country within a given period of time and, in some cases, tend to go back and forth between their home country and the U.S. According to Card, this

makes any study difficult because there is a constant flux within the cross-sectional data obtained.

Anthony M Santomero (2005), President of the Philadelphia Federal Reserve, focused on two other topics of interest: the housing market and the labor market. The results of this study demonstrated that there was little effect caused by immigrants on the labor market even among low-skilled workers. An influx of immigrants within a given area actually leads to higher demand in housing. President Santomero urges people to look at the parallels between now and the early 20th century, a time in which the United States experienced an influx of immigrants. The idea emphasized by President Santomero is to consider the effective assimilation and societal acceptance that was experienced than and how it can be applied to recent times.

When it comes to the impact of illegal immigration in economic terms, most research, if not all, has concluded that undocumented migrants are paid less than minimum wage. The reasons underlying this finding, according to Espenshade, is that there is a reduced labor market experience for immigrants along with lower job-related skills or, in some cases, employer discrimination. Although undocumented migrants worked nine additional hours per week, they were still paid less by the construction, manufacturing, and other industrial industries than the minimum per hour, compared to the U.S. production and nonsupervisory workers (Espenshade, p. 207). The negative impact of immigrants on wages and job competition is dismissed to a certain extent but how about immigrant's use of social services?

Adrian Pantoja (2006) analyzed Proposition 187 by using logistics of the 1990's and illustrated under what assumptions the law was passed. According to Pantoja, the U.S. experienced an incredible increase in immigration in the 1990's: 9.1 million immigrants were admitted and undocumented immigrants were numbered at 8 million (Pantoja, Immigration and Naturalization Services 1999, p. 515). California was the creator and State that allowed for the passage of Proposition 187, which was meant to discourage immigrant use of social services. The concern that prompted the passage of this law was the financial burden many thought illegal immigration was placing on the State by their unfair usage of social services. The widespread misconception that immigrants depended on social services was based on the idea that they came from underdeveloped countries and therefore lacked the skills necessary to survive. Former INS director Alan Nelson believed that laws like Proposition 187 would reduce the immigration inflow since many were only drawn to the social services offered by the States (Pantoja, p. 517). The law was meant to prevent illegal immigrants from accessing public services like education and non-emergency medical care. Proposition 187 was later ruled by a district court as unconstitutional, yet Congress still addressed citizen concern by responding with doubling the INS budget and increasing border enforcement during 1994 (Pantoja, p. 516).

Christina Gathmann of Stanford University evaluated within her study an effective way to reduce the influx of illegal immigration from the Mexico border to the U.S. Her study demonstrated that even though border security was increased and the budget was multiplied by six times, the change in crossings has only reduced illegal immigration by ten percent (Gathmann, pp. 50-1). The result of such a waste of money is that people simply find more discreet and treacherous locations to enter the U.S. She suggests that the U.S. charge a fee at the border for a temporary work visa since, her along with other researchers have found that people tend to migrate back to their home country at some point in time.

All the research that has been undertaken up to this point has been a hard and arduous task since there is no accurate way to track every immigrant that passes through our border. The most interesting study mentioned by Marcelli was conducted by the University

of Southern California in the late 1990's, which disproved the very foundation on which Proposition 187 and similar acts of 1996 were built. The results of the study showed that unauthorized Mexican immigrants from 1995-1996 were unlikely to apply for government assistant programs and when they did receive a public assistance program, they received significantly less than U.S.-born residents (Marcelli, p. 47). Marcelli's study concluded that though there are many reasons for reform, they do not include immigrant's use of public services. He notes that a major problem that all these studies face is the lack of credible and systematic research on the economic impact of immigration. Proposition 187 has been analyzed by many researchers since it was one of the weakest formatted policies passed by a State. Studies have helped shed light on the situation by helping the public understand to what extent the reasons for Proposition 187 could be substantiated.

Drafting and defining laws is a long and rigorous process. Immigration is a controversial topic which appears to have as many supporters as it does opponents. Stereotypical attitudes toward ethnic groups in society have developed due to different factors, as was examined earlier in the report. Security within our borders is a huge part of this subject and reason for much debate, especially after the attack of September 11, 2001. Those involved in the attack had entered the United States with visitor visas. John Dovidio, Victoria Esses, and Gordon Hodson (2002) address the changes in attitude that the general population underwent due to the 9/11 attack. Politics and policies are influenced by the public and therefore it is important to understand how attitude can be influenced by such traumatic events. The study compares the United States to its northern border country, Canada. Focusing on the principles on which both countries have structured their immigration policies, the study attempts to illustrate the parallels in policy. Both have aimed their immigration policies at particular goals by taking into consideration family unification and economic contributions on behalf of immigrants. Public attitude has influenced the formation of such laws and therefore favorable public attitudes will lead to fairer, nondiscriminatory policies. Dovidio, Esses and Hodson believe that regardless of whether it is Canada or the United States, a healthy attitude toward immigrants should be promoted since it could have a very serious effect on the overall success and behavior of immigrants. The study conducted by Dovidio, Esses and Hodson within Canada found that people perceived immigrants negatively whether they failed or succeeded economically, concluding that people feared competition in general and immigrants were perceived as such (Dovidio, Esses, and Hodson, pp. 401-02). People therefore supported laws that would attack or restrict what they identified to be the "enemy" in an effort to reduce competition. Unfavorable attitudes will only encourage more restrictions on immigration and fuel discrimination.

A Gallup poll taken in June 2001 was used to demonstrate the attitudes of Americans prior to the 9/11 attack. The results are listed as follows: 62% of respondents saw immigration as a "good thing," 75% indicated that immigration had been a "good thing" in the past. A plurality of respondents in the study, 42% to be exact, wanted to keep immigration at current level, and 14% wanted to increase immigration, contrary to 41% who wanted to decrease immigration. The attitudes have been consistent for the past 35 years and, according to the study, the most negative attitudes were expressed during economic downturns (Dovidio, Esses, and Hodson, pp. 72-73). Canada was no exception with similar perceptions. Dovidio, Esses, and Hodson use a schematic sketch that shows cause and effect between current perceptions and attitudes are correlated. The graph focuses on the psychological processes that an individual goes through to handle an event such as 9/11. A possible result of such event is that people within the in-group (U.S. born) can begin to see the out-group (immigrants) in a homogenous way (Dovidio, Esses, and Hodson, p. 74). Allowing for negative perceptions to formulate also allows room for conflict and dis-

unity within society. A long-term effect predicted by Dovidio, Esses and Hodson was that as a result of the 9/11 attack a recession would lead to a fierce competition for resources and immigrants would be seen as competitors, deepening the use of negative stereotypes and prejudices.

To ensure security, Congress has passed many bills that would allow local police enforcement to perform a duty once reserved for federal government: deportation. Daniel Booth (2006) mentions that though there are supporters of these bills who think them unnecessary to ensure homeland security, there are also those who believe that local law enforcement does not need the extra case load. The argument that opponents use is that law enforcement has worked hard within their respective immigrant communities to build a trust. Police officers depend on this relationship to get support whenever they are looking to resolve a crime. The fear that would be evoked by the passage of such a law would only propagate fear and silence among these communities since they would refuse to cooperate with police officers and withhold valuable information. (Booth, pp. 1064-5) Booth is attempting to build a case against using local enforcement to enforce federal immigration law. He argues that diverting limited resources to enforcing federal law would hinder their ability to respond to other situations and his strongest argument for not using local enforcement is that this type of force would destroy relationships with immigrant communities. Booth suggests that this would only cause confusion and hinder criminal investigation.

Anne Morrison Piehl (2005) of Rutgers University, while at a conference at the Philadelphia Federal Reserve presented research that extended from earlier work with her co-author on the correlation between crime and immigration. Piehl's research found that cities with higher proportion of immigrants had no higher crime than similar cities with few immigrants. Incarceration rates between immigrants and native-born also demonstrated that immigrant involvement in crime is less than native-born, even when it came to native-born with similar characteristics as immigrants. Piehl took the study a step further and looked at more recent years and found that there was a widening gap between natives committing crimes and native born. She believes that the stricter laws passed in 2005 acted as a deterrent and though she would have assumed that this would have prompted permanent residents to become U.S. citizens, it did not. Crime was not reported either, so the law was effective in its principle goal.

Booth attempts to define the scope of power of the federal government and the states when it comes to immigration. The constitution does not make mention of the powers states have when it comes to immigration and states have in many cases assumed those powers. Attempts of passing civil laws have been recorded but they have either been invalidated by courts or preempted by federal laws. Booth mentions that others have viewed this as another reason why states have no power when it comes to enforcement of federal legislation and also "...recognized need to conduct foreign policy with a single voice" (Booth, p. 1070). Booth acknowledges the idea that Congress cannot command states but there is a way in which they can be asked to assist on an assignment such as in a situation concerning national security. Booth believes that such situations make it absolutely necessary that Congress define states rights when it comes to immigration and this will most likely result in a total change in the function of the federalist system.

As noted previously all studies suffer from a similar weakness, not having an accurate way of measuring the number of undocumented immigrants within the country. Undocumented workers are hard to detect because there is no survey developed that will get any of them to answer truthfully to their status within the country. Espenshade depended instead on the number of apprehensions made at every border, which does not necessarily capture those that have reached the U.S. successfully but does offer a more reliable

number than other sources, such as the U.S. census. An interesting fact presented within the report concerns the San Diego border, Chula Vista, which covers only about 1 mile of border yet makes more apprehensions than any other. Five out of six apprehensions are Mexican nationals (Espenshade, pp. 196-7). Another problem with the apprehension information is that some are captured many times within a given period and continue until they accomplish their goal. Espenshade highlights the work of Warren because he bases his numbers on people who overstay their visas as those who enter the U.S. inconspicuously, which is more credible and less modest than the census bureau. Mexico remains to be one of the leading countries in immigrant population in the United States, approximately forty percent of total immigrating population (Espenshade, p. 201).

The level of assimilation on behalf of immigrants is important since it helps determine to what extent immigrants have adjusted to the culture away from home. A study of immigrant assimilation conducted by Card focused on the children of immigrants, which account for ten percent of teenagers nationwide and just what they are doing in terms of integrating into the culture they were born into. This indirectly helped him understand to what extent the parents had accepted or assimilated into the culture. Card defines second generation, "as people born within in the U.S. with at least one foreign born parent" (Card, p. 20). Card compares both the education level of immigrants and second generation to natives. Immigrants have about 1.2 to 1.4 fewer years of education than natives, while second generation immigrants have 0.3 to 0.4 years more education then natives. The study also demonstrated that among men, immigrants have wages that are 18 to 23 percent lower than third and higher generation natives, while second generation immigrants have four to eight percent higher wages. Women had a larger immigrant gap in the probability of working at 13.6 percent lower annual employment rate than natives (Card, p. 21). Yet second generation women were more likely to work than third and higher generation natives.

Card reported that second generation women's wage gap was about the same but for immigrant women the wage gap is smaller than for immigrant men. He suggested that such results may reflect the relative selectivity of labor force participation among immigrant women. Card explains that higher wages among second generation immigrants can be explained according to their higher education and geographic location. Card concluded that immigrants within the United States earn less overall, after controlling for education, the wage gap for immigrants was less than ten percent in comparison to the wage gaps for African-Americans and native Hispanics (Card, pp. 21-2). He was able to demonstrate graphically that even though immigrants would not be able to "catch up" in terms of wage, second generation immigrants were able to "catch up" due to the level of education. Immigration does not seem to have any adverse affect on the economy, but Card does believe that it would be more beneficial if more longitudinal data existed. Many programs were set up in the pursuit of Americanizing those immigrants who had come into the country in way to assimilate into the culture and society, but the problem, as Yuval Levin (2007) mentioned, is that those programs are inadequate when it comes to such preparation.

Levin approached this matter by looking at the actual problem, which is not immigrants themselves, but the outdated legal system that was meant to direct, manage, and assimilate them. Levin attempts to clarify the situation that the United States government is facing when it comes to immigration and resolving what has been a theme of heated debate in politics. Levin reports that in 2005 over a million people became permanent residents of the U. S., of which twenty percent received employment visas, thirteen percent were refugees and asylum-seekers, four percent were "diversity immigrants," and sixty percent were relatives of naturalized citizens (Levin, p. 50). The idea of family unifica-

tion has been a principal on which petitions have been approved and immigration law has been formulated to a certain extent. Mexicans have been the prime users of this system making them one of the largest populations in the United States. Levin argues that even though keeping spouses and children united is important and the right thing to do, it does not follow that the U.S. must also accept the influx of extended family. Levin believes that the most basic way to reduce immigration is to adjust the law to limit reunification to "...the holding together of nuclear families" (Levin, p. 52). This is a reasonable way to reduce the number of immigrants and still maintain the principles on which the United States was founded.

Immigration policy as researched by Yueh-Ting Lee and Victor Ottati (2002) has been structured to benefit those of Canadian and European descent and restricted individuals from such places as Africa, Asia, Latin America, and the Caribbean. The assertion is based on an analysis of immigration statistics and on the laws and policies that have been passed over time. Lee and Ottati also build on the restrictions that the U.S. government has placed on the immigration flow that comes from Mexico and the possible threats that they can pose to national security. The hypothesis offered by the authors is called the In-Group-Out Group Hypothesis, which focuses on the tendency to evaluate the ethnic out-group more negatively than the ethnic in-group (Lee and Ottati, p. 621). The study states that researchers have suggested that the in-group favoritism may arise from motivation to maintain a positive sense of social identity. The primary purpose of this research was to measure the attitudes toward Proposition 187. Lee and Ottati describe it as follows, "Because the proposition would negatively affect Mexican immigrants, we predicted that Anglo-Americans (for whom Mexicans are the out-group) would support Proposition 187 more than would Hispanics and Latinos (from Central and South American countries other than Mexico) for whom Mexicans are the in-group" (Lee and Ottati, p. 630). Similar hypothesis have been used in various other situations in an effort to analyze attitudes and prejudices and gain some insight on what governs the general publics attitude.

Howard Goldfarb (2005) takes on the Bush administration that has either put in place or offered different political strategies in an effort to solve the illegal immigration dilemma. Amnesty, deportation using ICE (Immigration Customs Enforcement) or local state enforcement, to penalizing employers for hiring an undocumented worker knowingly, are just some of the options that have been presented to either reduce or eliminate illegal immigration. Opponents and supporters exist for all these options, yet certain employers will face a tough call when it comes to the penalties that are imposed on business. Companies will not only have to worry about competition amongst themselves, but analysts state that the costs implicated in verifying the legal status of every employee will not only be costly but time consuming. The goal that all these reforms are trying to achieve is elimination of the undocumented worker. But how realistic is this goal?

The Bush administration hinted at the fact that at the moment none of their options would achieve this goal and Bush inclusively suggested a revised temporary worker program. Many people in fact stay even after visas are expired since they need to work to support their families. Goldfarb refers to Ron Fuller, a Harvard law professor, who criticized the utilitarian theory as too simplistic in nature. Fuller believes that creating laws by thinking in end results first is not effective since it would be like starting from the top down. He reasons that in order to formulate effective law there must be "means-cost," or what Goldfarb referred to as "...the price of attaining the law's objective" (Goldfarb, p. 1884). Goldfarb uses the case of Sure-Tan Inc v. NLRB to demonstrate some of the pitfalls within current legislation and its interpretation. The question presented in the case was whether the NLRB protected all workers regardless of worker's status within the country.

The majority within the court wanted to protect the interests of natives over those of the illegal immigrants. Interpreting the law strictly to apply to only legal employees would hopefully discourage employers from hiring illegal immigrants and discourage illegal immigrants from coming into the U.S., Justice Brennan noticed the pitfall within such interpretation and stated it as follows:

Once employers, such as petitioners, realize that they may violate the NLRA with respect to their undocumented alien employees without fear of having to recompense those workers for lost back pay, "their incentive to hire such illegal aliens" will not decline, it will increase. And the purposes of both the NLRA and the Immigration and Naturalization Act that were supposedly served by today's decision will unquestionably be undermined. (Goldfarb, p. 191)

Peter Burns and James Gimpel (2000) researched attitudes toward immigrants focusing on the economic drain that is associated with immigration. Burns and Gimpel examine whether there is an existing link between attitude to racial prejudice or economic insecurity. Many investigators have found that opposition to immigration is most prevalent during recessionary periods. Studies have also shown a correlation between negative sentiment toward immigration during times of high unemployment and economic recessions. Researchers have presented the idea that economic competition among rival groups has led to hostile and prejudicial attitudes that can arise at any given moment leading to conflict. Burn and Gimpel define stereotype and prejudice as follows, "...prejudice is ultimately an expression of self-interested calculations based on one's economic position... stereotypes are widely used to generalize about the characteristics of people through the assignment of simple labels that purportedly represent group traits" (Burn and Gimpel, p. 203). Attitudes that are rooted within racism in general are founded in pure ignorance. Lack of understanding and research on behalf of certain individuals can lead to poorly founded perceptions. Before any policies are supported or turned down the general public must inform themselves of the implications involved with all major legislation, especially to avoid passing a law that would abuse the natural human rights of any individual or group.

To complete the analysis of attitudes is to narrow it down to employers. Karen D. Johnson-Webb's (2002) research gives insight on the hiring behaviors and attitudes that employers within North Carolina possess. Her decision to focus on the Triangle of North Carolina which consists of Orange, Durham, Chatham, and Wake counties was based on their low unemployment rates and growing service and construction industries which were attracting many immigrants to move in to North Carolina. The demand for employees within this state led to a recruitment on behalf of employers among the Hispanic population. Once hired, people began to refer people to the employers and therefore the Hispanic population increased. Native born also reject going into certain industries which helped raise the demand for unskilled labor. Employers use numerous methods to fill their labor demand and some of the ones mentioned by Webb are: newspaper, advertising, or even contacting Mexican consular within particular cities about contracting Mexican nationals. Various interviews were conducted to understand employer behavior and if there was a lack of sources Webb would supplement by interviewing media personnel and consular officials. Webb interviewed 26 employers within the hospitality and service industry who hired Hispanics for positions such as cooks, maids, custodians, and bus people. She uses three standard size categories that are as follow: 50 to 99 employees, 100-499 employees, and 500+ employees (Webb, p. 412). In her study she assigns a number to those interviewed and gives a brief description of professions to maintain confidentiality.

Her study demonstrated that employers preferred Hispanic workers, notably Mexican, because they perceived them to have a excellent work ethic and were hardworking.

Employers were very honest about the way they went about hiring Hispanics and their appreciation for their work ethic. The answers from every employer to the questions were consistent with such beliefs. Employers within the agricultural industry brought in Mexican national on the H-2 visa and were disappointed when they either left to their country of origin or chose to go work in the city. Employers were willing to accommodate the needs of their Hispanic employees and some interviewed admitted raiding competitors to win over their Hispanic employees. Webb also pays special attention to what is not mentioned by the employers since this also leads to a more vulnerable population due to their status within the country. She perceives "work ethic" to: "...be a euphemism for a complaint, vulnerable workforce" (Webb, p. 416). Webb notes that immigrants are less likely to complain about work conditions or seek compensation if they were injured on the job, making them a vulnerable population. The study conducted by Webb demonstrated employers willingness to accommodate Hispanic workers has led to the migration that occurred over the last 20 years within the Triangle area.

Espenshade uses a dual labor market theory to explain why natives are not affected by employers' decision to hire immigrants. The theory focuses on chronic demand of industrial capitalists for foreign workers. Espenshade explains that employers have to prepare to face times when their product or service may not be in high demand, making it a highly unstable environment, leading to underutilization of company capital. The extra cost will primarily affect workers, since employers will have to lay off employees to reduce overall expenses. The secondary sector will end up within an unstable situation leading to job insecurity, low wages and little upward mobility. The theory argues that low skilled workers will be forced to look for jobs in the primary sector of the economy. The primary sector requires higher skills but also offers better pay (Espenshade, pp. 204-5). Such a situation leads employers to resort to foreign labor to resolve such weaknesses.

Previous research demonstrates that the source of many negative attitudes about immigrants and immigration policy are frequently based upon inaccurate information and misconceptions. While much of the research has focused on demonstrating the incorrectness of these misconceptions, little research has focused on employer attitudes, especially determining whether employer attitude is influenced by reliance on immigrant labor. The proposed research will examine the attitudes of an important sector in our society, business owners and general managers. By evaluating attitudes of local business owners and general managers towards immigrants and immigration policy, it is hoped that the research will identify an important source of those attitudes (reliance on immigrant labor, industry, and/or ethnicity).

Research Question: Are attitudes towards immigrants and immigration policy affected by reliance on immigrant labor, industry, and/or ethnicity?

Hypothesis:

1) Hispanic owned businesses that rely on immigrant labor have more positive attitudes about immigrants
2) Hispanic owned businesses that do not rely on immigrant labor have less positive attitudes about immigrants
3) Non-Hispanic-owned businesses that rely on immigrant labor are more positive about immigrants
4) Non-Hispanic-owned businesses that do not rely immigrant labor are less positive about immigrants

Methodology

The research was conducted by identifying different business leaders by using the Hispanic Chamber of Commerce and the Greater San Antonio Chamber of Commerce directory. The Hispanic Chamber of Commerce and San Antonio Chamber of Commerce were chosen because they would facilitate the identification of Hispanic-owned and non-Hispanic-owned businesses, as well as locate businesses that rely heavily on immigrant labor and those that do not. By choosing from these industries and categories it can be determined whether attitudes about immigration can be associated with ethnicity, type of industry, and/or need for skilled vs. less skilled labor.

The businesses were selected from the websites and were chosen from the following industries: construction, landscaping, service, as these are industries that typically rely upon lesser-skilled labor, which was assumed to mean higher reliance on immigrant labor. Businesses were also selected from banking, consulting, and similar industries since these industries tend to rely upon highly skilled labor, which was assumed to mean less reliance on immigrant labor. The purpose of the study is to determine whether Hispanic owners differ in their attitudes toward immigration policy and immigrants than non-Hispanic owners, and whether those who rely more heavily on immigrant labor are also more supportive of less stringent immigration policies. The information attained will help identify linkages between business owners' views about immigration policy and immigrants to their actual or potential reliance on this source of labor (refer to Table 1.1).

The owners or general managers of the businesses were contacted and provided with a survey (see Appendix A) and informed consent form. The interview consists of 8 open-ended questions. The responses for the interviews were reviewed and summarized in order to determine general attitudes about immigrants and immigration policies.

Table 1.1

	Hispanic Owned	Non-Hispanic Owned
	Business Expected to Utilize Immigrant Labor →	Business Expected to Utilize Immigrant Labor
	Business Not Expected to Utilize Immigrant Labor →	Business Not Expected to Utilize Immigrant Labor

Results

The following is a summary of responses obtained from returned questionnaires. At this time, only four questionnaires were completed, all from Hispanic-owned businesses. Three of the businesses fall within industries that are not considered highly dependent on unskilled labor, and one business falls within an industry that does rely more heavily on unskilled labor. The respondents were asked to identify their ethnicity and party affiliation in addition to their type of industry in order to see whether these factors also influence attitudes. For ease of comparison, responses will be identified as:

Owner 1—Hispanic, Republican, Landscaping Industry
Owner 2—Hispanic, Republican, Consulting Industry
Owner 3—Hispanic, no political party ID, Consulting Industry
Owner 4—Hispanic, Republican, Finance Industry

Question 1.) Do you believe it is wise to give citizenship to the 12 million or so illegal immigrants already in the United States? Why or why not?

Owner 1-- "I do believe it is good to give them citizenship...giving citizenship to people who have clearly demonstrated that they are working in this country for years...have homes have families...and are productive citizens...we have allowed it knowing that they are probably illegal...we like their service...the way they cut our yards...so we are not going to say anything...doesn't make any sense to kick out 12 million people..."

Owner 2-- "I believe it is in our country's best interest to offer a pathway to legalization with potential for citizenship to undocumented immigrants who have demonstrated positive citizen traits/behaviors such as: working, no serious criminal background, basic command of English, knowledge of US laws, etc."

Owner 3-- "They are already here and working, why not pay taxes. This would certainly make our country better."

Owner 4-- "I believe we should put the 12 million illegal immigrants on a path legalization."

Question 2.) President Bush is planning to introduce a temporary worker program (brief description will be provided, if necessary); do you think this program will be effective in reducing the number of immigrants entering the country illegally? Why or why not?

Owner 1-- "...[W]e already have temporary worker program...H2-B Visa program...The majorities of these people that come here and work they want to go back home...want to earn what they otherwise would not be able to earn in their own countries. The H2-B program...this last year the program was attacked and specific rules were not re-allowed...that forced us to compete for a very small pool of visas...66,000 for the entire country we can use 66,000 just in South Texas."

Owner 2 -- "An effective temporary worker program is part of the comprehensive solution to our current broken immigration policy. By offering a practical temporary worker program, workers who wish to come and go will be able to do so without having to break

the law in order to work in the U.S."

Owner 3-- "It will look good on paper, but they are still going to enter the land of opportunity, better pay, better conditions for families---temporary classification or not."

Owner 4-- "Yes, if citizens of other countries can apply to participate in the temporary worker program and the process is simple enough and affordable, it will encourage people to apply for the program rather than come over illegally. The cap, if any, must fluctuate with the economic demands for our country rather than be set arbitrarily."

Question 3.) Do you think of the wall that is being built along the Mexican-American border is good idea? Why or why not?

Owner 1-- "No it is not a good idea.... I was standing on the Berlin Wall when it came down. It does not help; it is a barrier yes but it is a temporary barrier-- there is always ways around it. The roots of that idea is based on what I can only term as racism. The wall is just a bad idea. It negatively affects our economy. We have a very close relationship with Mexico, our city does... huge cross border traffic... but once... you make it more difficult to cross it just slows the economic progress...."

Owner 2-- "Like any country, our borders need to be protected and secured. However building a wall without specific justification at every location is a waste of tax dollars and will not solve the issue at hand, which is illegal entry into the U.S."

Owner 3-- "Only if they build it and decorate it because no one will stop from crossing into this great land of ours unless the greatest technology is used on body sensing devices and other such technology and robots [which] catch these individuals. And that costs money and human resources!"

Owner 4-- "If the wall is really about security, then why isn't one being proposed for the northern border? Bottom line, the fence is being built to keep out Mexicans and OTMs (other-than-Mexicans). Is there a proposal to build a fence or barricade along the coast line of Florida to prevent Cubans from setting foot on U.S. soil?"

Question 4.) Do you believe the local economy is being affected by the recent deportations of illegal immigrants? Why or why not?

Owner 1-- "I don't think so, not yet. Deportation of illegal aliens has been happening forever but the majority of those have happened in other areas.... I don't think it is affecting us yet but certainly can but our economy is really based on small business... but corporations like Valero... are probably not going to hire illegal immigrant... crossing the border illegally you are here to do some labor work.... I know there is companies all over the place that are in the construction, service industry that are hiring illegal immigrants in order to survive..."

Owner 2-- "Our economy is negatively affected anytime employers are limited because of their inability to find skilled workers to grow their company."

Owner 3-- "Of course, who will do the jobs immigrant people do."

Owner 4-- "Locally, No. Most immigrants bypass San Antonio for other larger cities or places where there are labor-intensive operations like the agricultural fields of California."

Question 5.) The United States government imposes a fine on employers who hire illegal immigrants knowingly, and can also include up to six months in prison. Do you think the fine is fair? Why or why not?

Owner 1-- "I think its fair... it's the law... no one is above it.... If you are doing something illegal, you should pay the consequences. What I don't agree with is the federal government dictating to me that I have to be their investigator... that is their mandate that is in their purview to determine who can legally work in the country...."

Owner 2-- "The fine is not fair because employers often are hiring immigrants illegally because a legal method -of employment is not available to them; so they are left without a viable option. Also, often employers are presented with documents which appear to be legal, but may not be."

Owner 3-- "Fine is fair, jail is not, there would be an economic impact to the employees, families, and the community who may depend on these businesses."

Owner 4-- "No. Because most businesses do not "knowingly" employ illegal workers. If legitimate looking documents are presented to an employer, it is hard to tell if the documents are legitimate or not and rather than risk going to jail, we might see cases of employers utilizing racial profiling to determine if they want to accept documents from a person that they might suspect is illegal due to the color of their skin, accent or other features."

Question 6.) Punishing employers is intended to change hiring practices. Do you think there has been an impact on the hiring practices in San Antonio? Explain.

Owner 1-- "I don't think so because we have not been hit with any huge raids... Frankly we do not have those kinds of businesses... federal government is not looking for the guys that just have 100 employees they are looking for... manufacturing plants that have a large number of illegal aliens.... Every employer that does hiring knows whether you have an illegal or non-illegal. It is not my job to determine whether social security administration created this card for this person... I need that employee so I am going to hire them."

Owner 2-- "Yes, San Antonio has a significant construction sector, which is being gravely affected by employer raids and fines. They will be forced to reduce operations for fear of retribution and sanctions. This is not helpful to our already soft economy."

Owner 3-- "I know it has impacted some landscaping businesses and construction businesses in their hiring practices."

Owner 4-- "No. Businesses will hire people, legal or not, if that's what they need to stay in operation."

Question 7.) Do you believe that illegal immigrants are hurting the San Antonio labor force by taking the jobs of less-skilled American workers?

Owner 1-- "No, absolutely not... Earlier this year I had a contract to pick up trash on the highways. I could not find employees... because the visa program had been changed. I was asked to come to a job fair down at the courthouse.... I hired 12 people on the spot. Ten of those people did not last three days, two of them lasted for a week... Why? Picking up trash on the highway is not hard work... They did not want to work... But if I had 12 people from Mexico on the visa program they would work all day and night if I told them. Because that is my experience with these people."

Owner 2-- "San Antonio has one of the lowest unemployment rates, so clearly there is not a shortage of jobs for those who seek work. San Antonio has long benefited from labor due to its close proximity to Mexico. I would say quite the opposite, the availability of an immigrant workforce in San Antonio has allowed it to grow and thrive."

Owner 3-- "Less skilled American workers do not want to work the jobs that immigrants are willing to do. They would rather collect whatever benefits are available from local and federal agencies."

Owner 4-- "No. There is shortage of construction workers. Just ask any contractor. However, with the economy slowing down, we are already seeing a demand for less workers and as result many illegal and legal workers are returning to Mexico or their place of residency as jobs are not as readily available anymore."

Question 8.) What do you think would be an effective and fair immigration policy?

Owner 1-- "First identify who we want to keep... these guys are productive these people are not... productive ones get to stay... but you need to pay fine... but it has to be something that is fair because forcing these people to pay ten of thousands of dollars... its not fair. They helped build this economy even the ones we don't want to keep... We need to allow... the visa programs and allow those people to come over here and work legally... but we need to allow people to come in to work with the specific intent of becoming U.S. citizens... Some families are going to be hurt... speaking emotionally and socially... some families are going to be torn apart... unfortunately they were here illegally and they did not work... the way they should have worked... or they broke a law, robbed a bank... whatever they did we don't need those people here."

Owner 2-- "One which takes security fears out of the main discussion and focus on meeting our economic needs in order to stay regionally competitive and while at the same time remaining sensitive to family unification."

Owner 3-- "I would like to see the United States Government leadership meet with the Mexican government Leaders and find ways in which to improve the infrastructures of that country, provide financial means to improve the salary base and other studies to improve the situation in that country. If the Mexicans had better opportunities, better jobs and better quality of life in their country, why would they come to the U.S."

Owner 4-- "We need a comprehensive immigration policy that provides for both security and a guest worker program. Both must be implemented hand in hand and not with piece-

meal legislation."

Analysis

To reiterate, the hypotheses were proposed as follows: 1.) Hispanic owned businesses that rely on immigrant labor have more positive attitudes about immigrants, 2.) Hispanic owned businesses that do not rely on immigrant labor have less positive attitudes about immigrants, 3.) Non-Hispanic-owned businesses that rely on immigrant labor are more positive about immigrants, and 4.) Non-Hispanic-owned businesses that do not rely immigrant labor are less positive about immigrants.

The research, due to the limited number of interviews, was only able to focus on hypothesis one and hypothesis two. For instance, the response to question one demonstrated a positive sentiment toward immigrants since all participants believed that there should be some kind of legalization for the estimated 12 million already in the country. Though many different reasons were given as to why, their attitudes toward immigration were consistent throughout the questionnaire.

The results attained reinforce to a certain extent that hypothesis number one is correct. Meanwhile, the results also suggest that hypothesis two is incorrect. From the results gathered it can be deduced that Hispanic business leaders are permissive of immigration, indicating that there may be a correlation between ethnicity and attitude and for the moment demonstrating that reliance on immigrant labor does not play a major role within attitudes toward immigrants and immigration policy. All the participants noted the economic hardships that industries like construction and hospitality had to endure due to some of the recent policies, some of which are mentioned in the questionnaire. The research questions were aimed at whether attitudes towards immigrants and immigration policy were affected by reliance on immigrant labor or ethnicity? This question helped guide the research and when answered demonstrate that it does not matter if a particular industry is affected directly or not, those participants interviewed all believed that immigrants should be placed on a path to legalization.

Another way to interpret the data was that the majority of the responses were made by participants that politically identified themselves with the Republican Party. Therefore it can be suggested that Hispanic Republicans tend to be more permissive or less stringent when it comes to immigration and immigration policy as opposed to non-Hispanic Republicans. Though party identification does not immediately seem to be the most influential factor, since the Republican Party typically is more conservative in their approach to immigration issue. The party has consistently supported limiting immigration and reducing the number of immigrants illegally living in the United States through deportations and increasing funds for Immigration and Customs Enforcement (ICE) efforts. Therefore it can be seen that even though the individuals surveyed identify with the party there does not seem to be a strong connection between their opinions and the agenda of the party. Yet this is a small sample being analyzed and until enough surveys are conducted the results will remain questionable.

Conclusion

The results of the study conducted was limited by three factors, lack of accurate information on number of undocumented immigrants, employer apprehension and time constraints. Other studies have found some of the same limitations as the one conducted within this research paper. People that are directly affected by this situation fear divulging too much and getting caught within a legal snare. Though it would be of unlimited value

to be able to attain the correct number of undocumented immigrants, it must be kept in mind that this is a vulnerable population. When contacted, certain employers felt that it was best to just not say anything for fear that the information may be leaked to the media since they openly admitted their fear. Others simply ignored the numerous attempts to be contacted, preferring not to give too much information one way or another. Time is another constraint that limited the ability to search for other business owners to be interviewed. There are employers out there who are actually excited about participating in this type of study as proven not only by other researchers but by those who participated within this study as well.

The reality of it is that there is a very serious problem when it comes to dealing with immigration and the policies meant to control it. There is disagreement among the general population which can be attributed to conflicting attitudes. Before any law is passed there must be some type of acceptance on behalf of the public, otherwise Congress will be consumed by public outcry. Opinions are not sufficient to formulate effective laws. The ultimate goal is for Congress, "... to strike a balance between a sense of security for members of the national group, and maintenance of the values and principles on which current immigration policies are based" (Gimpel and Burn, 2004).

All research conducted within this field of study will undoubtedly lead to sensible laws that do away with misconceptions and analyze cold, hard facts. An interesting focus for future research would be to analyze whether the economy is dependent on immigrant labor and if so, is the economic recession currently being experienced linked to the mass deportations occurring all over the country.

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Attitudes of Future Teachers Toward Different Groups

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Abstract

Children learn from teachers what is appropriate and inappropriate behavior towards out-groups, whether or not the teacher's behavior is conscious or unconscious. This could have a devastating effect on a child's life if the teacher is high in Right-Wing Authoritarianism (RWA) and/or Social Dominance Orientation (SDO). In this study, 308 future elementary and secondary teachers in the south central and north central United States were studied to determine their level of RWA and SDO. Their authoritarianism was measured by the Right-Wing Authoritarianism scale and their social dominance orientation was measured by the Social Dominance Orientation scale in four universities across these two regions. Results indicate significant differences on RWA and SDO between the certification level of the teachers as well as the region of the United States. In addition, males were found to be higher in SDO across regions than females. This information will play a critical role in theory development and potential intervention strategies for use with training teachers.

Hate crimes are a problem that all individuals in the United States have to face, whether experiencing them personally or viewing the horrible results through the media. In the statistics of hate crimes reported to the Federal Bureau of Investigation (2007), law enforcement investigators found that more than half of all the incidents reported were motivated because of race. Racial differences are not the only out-group that can face these types of crimes. Gender, disabilities and sexual orientation are but a few of the many differences that may cause violence toward individuals. Many cases have been reported in the recent media, such as the murder of a black man in Jasper, Texas, a Filipino mail carrier being shot by a white supremacist, a 14-year-old boy being shot by a classmate for being gay, and a young gay man that was stabbed 19 times in San Antonio,

Texas. Furthermore, law enforcement investigators reported in 2007 that 15.7 percent of the crimes committed in 2006 were because of sexual orientation bias (Federal Bureau of Investigation, 2007). It is important to study the personality and motivation behind these types of hate crimes to determine appropriate and effective interventions to prevent such crimes from occurring in the future.

Many studies have shown that individuals model those they respect and believe to have power (e.g., Bandura, 1986, 1991, 1994, 1995, 1997). According to some social learning theorists and some developmental theorists, children learn beliefs and behaviors vicariously from a variety of sources, including parents, teachers and the media, which they then carry forward into adulthood. For example, Bandura (1965) studied the effects of childhood aggression and the media and found that children model the violence they view. Other research also supports the idea that individuals, especially children, learn violent behavior from watching aggressive shows on television (Bandura & Jefferey, 1973; Bronfenbrenner, 1986, 1995; Bronfenbrenner & Morris, 1997). In fact some theorists believe, individuals learn better from modeling than by what they are taught verbally (Grusec et al, 1978), demonstrating the potential power of this type of learning experience. Although everyone models behaviors for others, the authority figures that figure prominently during the most crucial part of a child's life are their parents and teachers. As children grow and move from elementary to secondary school, teachers become more and more important influences in children's present and future behavior. If a teacher models inappropriate behavior toward students in out-groups, it is highly possible that their students will grow up having learned the same inappropriate behaviors toward similar individuals in the same out-groups. Thus, teachers have the potential of strongly influencing a child's future behavior and continuing the cycle of hate.

Teachers play an especially important role in modeling appropriate and inappropriate behavior at school. Children have been taught since toddlerhood to respect these individuals as authority figures. The behavior that students exhibit from a teacher's behavioral model may not be apparent immediately after the behavior has occurred. The inappropriate behavior toward out-groups, however, may be quicker to appear, especially when they have been rewarded for that particular behavior. Also, the behavior may spontaneously appear later in the child's life, even when no immediate reward was given at the time of learning. For example, if a student observed teachers model particular behaviors toward certain groups, the child would, according to social learning theory, obtain the potential to use these same behaviors in the future (Bandura, 1965). Therefore, if the behaviors of the teacher exhibit a negative bias toward an individual in a particular out-group, the student observing that bias might in the future use the same bias to discriminate against that group. Some theorists believe that crimes based on differences between groups reduce after discriminating individuals gain a better understanding of individuals that are different from themselves (Altemeyer, 2001; Choate, 2003). However, if a child develops a negative bias without having this better understanding, they may become aggressive towards the particular out-group in adulthood.

Prejudice and Discrimination

A serious factor that many individuals in out-groups have faced is the hatred and aggression that in-groups demonstrate toward their particular out-group. The statistics for 2006 taken by the FBI showed that 7,772 hate crimes were reported from more than 12,000 law enforcement agencies across the United States (Federal Bureau of Investigation, 2007). Prejudice is defined as the emotional and cognitive reaction a person has toward individuals in out-groups, while the behavior that is directly linked to the cognitive and emotional activation of prejudice is termed discrimination (Haddock, Zanna &

Esses, 1993). Discrimination is the harmful actions both, physical and emotional, taken toward individuals in out-groups simply because they are part of that out-group (Parkins et al., 2006). Prejudice and its correlate, discrimination, appear to be a combination of personality traits within an individual that has been developing since childhood.

Personality Trait I: Right-Wing Authoritarianism (RWA)

Right-Wing Authoritarianism (RWA) is defined as a personality trait that includes the amount of unquestioning submission to authority figures (including, but not limited to, religious and political figures), inappropriate aggressive behaviors toward individuals from out-groups, and stereotypically masculine and feminine personality traits (Altemeyer, 1981, 1988). Studies have indicated that individuals high in RWA have very strong religious backgrounds (Altemeyer, 1992) and can be very hostile, especially toward individuals they believe to contribute to a dangerous and degenerating world (Altemeyer, 2004). In a study by Altemeyer (2003), he found that individuals high in RWA were seclusive, tended to maintain closer contact with individuals from their own religious groups, and leaned toward being "followers," not "leaders," in group situations. Another study by Sibley et al. (2003) found similar results, indicating that individuals who were high in RWA were afraid to make changes in their lives and tended to be very conventional (i.e., stereotypically masculine or feminine) in their thoughts and behaviors. Another study found that individuals high in RWA confirmed the heavy influence that religious beliefs have for these individuals. These researchers found that when particular public issues do not agree with these individuals' religious beliefs, they tended to be more aggressive (both passively and actively) toward individuals that upheld these public issues (Altemeyer & Hunsberger, 1992).

Personality Trait II: Social Dominance Orientation (SDO)

Social Dominance Orientation is defined as the desire for an individuals' in-group to dominate over out-groups (Pratto, Sidanius, Sallworth & Malle, 1994). The in-group of each individual can be different. An individual high in SDO believes that as the world becomes more competitive with more diverse groups, their attitude toward dominance and power over these groups will increase (Sibley et al., 2007). Individuals high in SDO want to be more dominant, regardless of the setting (Parkins et al., 2006). One study found that men tend to get promotions more often than females in the workplace (Group & Organization Management, 2006). By getting promotions over women in this setting, the men of this study may feel more entitled to the power and status achieved through this competition (Pratto, Sidanius, Stallworth, & Malle, 1994). This personality trait extends into other groups as well, including individuals with disabilities, race, and sexual orientation (Parkins et al., 2006). Therefore, if there is an out-group which tries to compete for the power, the goal of individuals high in SDO is to keep control and keep the differences between the groups unequal (Duckitt & Sibley, 2007).

Method

Measures

Altemeyer's (1996) Right-Wing Authoritarianism (RWA) scale was used to measure the level of authoritarianism in each subject. The RWA scale consists of 34 items that are scored using a 9 point Likert-type scale (-4 = very strongly disagree, -3 = strongly disagree, -2 = moderately disagree, -1 = slightly disagree, 0 = neutral, +1 = slightly agree, +2 = moderately agree, +3 = strongly agree, +4 = very strongly agree).). Data was recoded to provide a Likert scale ranging from 1 = Very Strongly Disagree to 9 = Very Strongly Agree. After data entry but before data analysis, indicated items were reversed

scored. The first four items are not scored, but are used to orient the examinee to the test. The last 30 items are summed to provide an overall score. Higher scores on the scale represent higher levels of authoritarianism in the subject.

The Social Dominance Orientation scale by Pratto et al (1994) scale was used to measure the level of social dominance in each subject. Unlike the RWA scale, the SDO scale consists of a 11 point Likert-type scale (0 = disagree strongly, 5 = neither agree nor disagree, 10 = agree strongly). Data was recoded to provide anchors at 1 = disagree strongly, 6 = neither agree nor disagree, 11 = agree strongly. After data entry but before data analysis, indicated items were reverse scored. The 16 item scale was then summed to provide an overall score for each subject. Higher scores on the scale represent higher levels of social dominance in the subject.

Participants

Participants were undergraduate or graduate students enrolled in teacher education classes at four mid-sized public universities. Two universities were located in the north central region of the United States and two universities were located in the south central region of the United States. Teacher education classes from which the sample was drawn included such topics as Childhood Development, Adolescent Development, and Teaching Students with Special Needs. The subjects were enrolled in these courses during the Fall 2002 semester. Data was collected during the first four weeks of the semester. The total number of participants was 308. However, 35 subjects were removed from the dataset due to missing data or because subjects were entering fields of education other than the classroom (i.e., nursing, speech-langange, etc.). This left the total number of subjects at 267.

One hundred and eighteen subjects (44.19%) from the north central portion of the United States and 149 subjects (55.81%) from the south central portion of the United States were used in the final dataset. The age range of the subjects was 17 – 54. One hundred and seventy-seven participants (66.29%) were enrolled in elementary school education tracks and 90 subjects (33.70%) were enrolled in secondary school education tracks at their respective universities. Each university's teacher education program was accredited by the National Council for Accreditation of Teacher Education (NCATE). Se Table 1 for a complete breakdown of the demographic variables within the subject pool.

Procedure

Institutional Review Board (IRB) approval was gained at each of the four universities used in this study. Proctors were trained in standardized administration procedures prior to administering the questionnaires to the teacher education students. Informed consent was read aloud and signed by each subject prior to the distribution and administration of the questionnaires. No incentive was offered to the subjects for their participation. Permission to collect data from each of the classroom instructors was obtained prior to questionnaire administration.

A demographic questionnaire was used to collect the following demographic information from each subject: gender, age, relationship status, subjects' status in college (i.e. Freshman, Sophomore), race/ethnicity, the anticipated certification level of the future teacher (elementary, secondary) and the teacher training track of the future teacher (i.e., Regular Education, Special Education, etc.). Data collection occurred within the first four weeks of the Fall 2002 semester.

Participants were given a packet that consisted of the demographic questionnaire, the RWA scale and the SDO scale. In addition to these questionnaires, other measures were also included that were part of a larger study. Measures were counter-balanced within the

Table 1
Subject Demographics

Demographic	*n*	*Percent*
	Ethnicity	
Caucasion/European American	*245*	*91.8*
Latino/a; Hispanic; Puerto Rican	*10*	*3.7*
African - American	*3*	*1.1*
American Indian/Native American	*4*	*1.5*
Asian - American	*3*	*1.1*
No Answer	*1*	*0.4*
Other	*1*	*0.4*
	Relationship Status	
Single/Never Married	*157*	*58.8*
Commited Relationship/Significant Other	*57*	*21.3*
Married	*43*	*16.1*
Divorced	*8*	*3.0*
Widowed	*2*	*.7*
	Certification Level Sought	
Elementary Education	*177*	*66.3*
Secondary Education	*90*	*33.7*
	Type of Teacher	
Regular Education	*200*	*74.9*
Special Education	*49*	*18.4*
Vocational Education	*11*	*4.1*
Physical Eduaction	*5*	*1.9*
Support Personnel	*1*	*0.4*
Administration	*1*	*0.4*
	Educational Classification	
Freshman	*30*	*11.2*
Sophomore	*39*	*14.6*
Junior	*119*	*44.6*
Senior	*62*	*23.2*
Special Student	*2*	*0.7*
Graduate Student	*15*	*5.6*
	Gender	
Female	*219*	*82*
Male	*48*	*18*
	Region	
South Central	*149*	*55.8*
North Central	*118*	*44.2*

packets to help control for fatigue. All the measures in the packet, except for the demographic questionnaire, utilized a Likert-type scale. In addition, each measure began on a separate sheet of paper.

Once the packets were complete, participating proctors reviewed the packets to ensure completion and returned them to the lead investigator for this study. Data was inputted into the SPSS 9.0 statistical package for data analysis. A total of 308 questionnaires were returned for use in the large study. Six packets were removed from the database due to unusual or incomplete responses. For this study, an additional 35 cases were dropped from the dataset prior to data analysis and SPSS 9.0 statistical package was used for this data analysis.

Results

To investigate potential certification level and region differences in the main research variables, a multivariate analysis of variance was conducted on the RWA total score and the SDO total score. There was no interaction effect between the certification level and region variables and the two dependent variables (Wilks' lambda = .998, F [2, 262] = .306, p = .737, partial η^2 = .002).

The main effect of region (north central vs. south central) was significant (Wilks' lambda = .851, F [2, 262] = 22.973, p < .001, partial η^2 = .149). Follow-up between-subjects effects indicate statistically significant differences between the mean scores of future teachers in the north central and south central United States on the RWA scale (p < .001, partial η^2 = .148) and on the SDO scale (p = .039, partial η^2 = .016). An examination of the mean scores of the RWA scale indicate that future teachers in the south central United States (M = 150.85, SD = 42.622) scored significantly higher than future teachers in the north central United States (M = 108.24, SD = 43.266). Furthermore, future teachers' mean scores on the SDO scale in the south central United States (M = 59.66, SD = 23.527) was significantly higher than future teachers in the north central United States (M = 54.08, SD = 22.565).

The main effect of certification level (elementary vs. secondary) was also significant (Wilks' lambda = .966, F [2, 262] = 4.658, p = .01, partial η^2 = .034). Follow-up between-subjects effects only indicated a statistically significant difference on the RWA scale (p = .025, partial η^2 = .019). The between-subjects effect on the SDO scale was not significant (p = .314, partial η^2 = .004). An examination of the mean scores of the RWA scale indicates future elementary school teachers scored significantly higher (M = 139.71, SD = 47.722) than future secondary school teachers (M = 116.89, SD = 44.418). An examination of the mean scores on the SDO scale reveals why the difference of values did not reach statistical significance [future elementary teachers (M = 56.69, SD = 22.214) vs. future secondary teachers (M = 58.18, SD = 25.210)].

Because of the disparity of sex in the teaching field, males and females were matched on the following variables: age, ethnicity, region (north central vs. south central), and certification level (elementary vs. secondary). The number of subjects within each sex was 48. This matched sample was then subjected to two t-tests examining the group differences on the RWA scale and the SDO scale. There was no group differences noted between males (M = 123.04, SD = 40.727) and females (M = 125.66, SD = 48.492) on the total score of the RWA scale (t [94] = -.286, p = .775); however, there were significant group differences between males (M = 69.43, SD = 26.368) and females (M = 56.09, SD = 22.107) on the total score of the SDO scale (t [94] = 2.686, p = .009).

Limitations to the Study

There were several limitations to this study. First, the sample was restricted to subjects from two universities in each region. This study cannot be generalized nationwide.

Another limitation was a low proportion of men in the current study. However, this may represent the correct proportion of male teachers making up the population of school teachers in the United States. Furthermore, past studies have indicated that males could negatively influence the mean scores on the measures used for the current study. Larger sample sizes with more proportional n-counts of males and females could further validate this hypothesis.

Discussion

This study found that there are there is a higher amount of negative bias in the form of RWA and SDO in the south central region of the United States. This indicates that these future teachers may consciously or unconsciously demonstrate verbal and nonverbal behavior toward students in out-groups once they enter the field. This higher amount of RWA and SDO could be explained by the higher number of religious authorities (i.e., evangelicals) located in the southern part of the United States. Past studies support the fact that those having high RWA and high SDO scores regularly attend church and have stronger religious backgrounds than those in the general population (Altemeyer & Hunsberger, 1992; Altemeyer, 2004). It is possible then that authority figures representing certain religious organizations could more strongly influence individuals in the southern part of the United States than those individuals located in the north.

As this study found, those individuals pursuing elementary certification obtained higher scores on the RWA scale, indicating that they desired to be submissive to authority figures, more aggressive toward individuals from out-groups, and have more conventional gender role orientation. Secondary education students tended to have lower scores on the RWA scale. Social Dominance Orientation was approximately the same across both groups. It would be important to pursue more reasons why these differences exist. Elementary education has traditionally been the purview of women, although more males are beginning to enter this predominately female occupation (Ivy & Backlund, 2008). Changes in the perception of gender roles and the socialization of females could be one possibility for these differences. In addition, past studies have also identified individuals having traditional sex roles (i.e., stereotypically masculine or feminine traits) believe that anything or anyone differing from these stereotypes are inherently wrong (Altemeyer, 1981, 1988).

This study identified males entering the teaching profession as being more socially dominant than women entering the field. The low number of subjects within each group in this study should be taken into account, however, and these results should be interpreted with caution. Many reasons could explain these differences. Males are traditionally raised as being dominant, aggressive and action-oriented (Ivy & Backlund, 2008). Traditional gender roles have males being dominating over their wives, making more money, and keeping the family safe. These traditional roles could trigger the cognitive attitudes of males high in SDO when they feel their dominance being threatened by individuals from out-groups (Englander, 2007). (Also, more males enter the education field at the secondary level (i.e., teaching grades 6 through 12)). This dominant orientation could follow these males into adulthood and into their future careers. Therefore, it is highly possible that these males may negatively influence their students and continue the cycle of dominance over perceived out-groups. This may reinforce what these students have learned in their home, especially if they were raised by very traditional and conventional parents (Altemeyer, 2004).

The purpose of this study was to identify personality traits in future teachers that could possibly be used as predictors for prejudice and discrimination toward students in their classroom perceived as being in out-groups. Future studies will attempt to build a

model for teacher prejudice and discrimination toward students of all ages. This could be pivotal for the development of interventions that could be implemented in the college classroom to prevent and/or lessen the negative bias children from out-groups face in their development.

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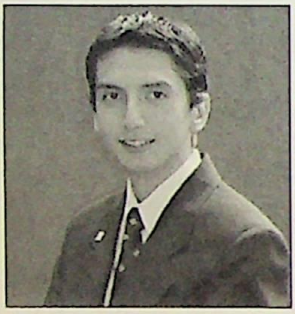
A Study of the Motivations and Issues that Drive College Students and Young People to be Politically Active



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Abstract

The youth vote has historically shown low numbers of political participation during elections. Since 2000 there has been some improvement, however, this year's presidential primaries and caucuses recorded high numbers of political participation from the youth, particularly among Democrats where Senator Obama and Senator Clinton inspired many young citizens to be politically active. This study reports preliminary findings from interviews of participants who were politically active students from St. Mary's University. The purpose was to find what were the important issues, motivations, and other circumstances that drove this group of students to be politically active. My research draws from other studies about the reasons why young people do and do not become politically active. According to the theories explored in this study, the main issues that influence the youth when it comes to voting is their perceived level of political information. Many young people feel they are not educated enough to make the right decisions about who or what to vote for. The students agreed that there is a need to educate the American youth to increase their political participation.

Research Paper

During elections labor unions, religious organizations, veterans, and other groups become important players possessing political capital to influence elections through voting endorsements. However, organized groups are not the only ones with political capital. Individuals also posses some influence over elections, especially senior citizens since this demographic group consistently votes in great numbers during Election Day. The one demographic group that has not participated in great numbers during elections has been the youth of the United States, particularly between the ages of 18 to 29 years old. This group has not shown an interest in participating in the political process when it comes to voting. Since the year 1971, when 18 year olds received the right to vote, and 1972 when

only 52 percent of their population participated in the presidential election, their numbers have consistently dropped below 50 percent voter turnout in the following presidential elections. The one exception was in 1992 when they reached above the 50 percent mark (Kirby, Lopez and Sagoff 2005).

In their issue brief, Oshyn and Wang (2008) argue that politicians have failed to address issues that concern youth and neglected to target them in their campaigns. This has led young adults to believe that politicians do not recognize their issues; thus, the youth dismiss the importance of participating in elections. However, voter turnout among the youth has been increasing every election cycle since the Presidential Election in 2000 (Oshyn and Wang 2008). The past two election cycles have reflected a clear trend of increased voter participation among the youth in presidential and mid-term elections. During the Presidential Election in 2004, there was a significant increase since youth voter turnout went from 40 percent in 2000, to 49 percent in 2004 (Kirby et al 2005). Mid-term elections have also experienced an increase. In 2006, youth voter turnout went up 3 percentage points going from 22.5 percent in 2002, to 25.5 percent in 2006 (Barrios, Kirby, and Lopez 2007).

During the presidential primaries taking place in 2008 the trend of increased youth voter participation has continued to show since more than 6.5 million young people under the age of 30 participated in the 2008 primaries and caucuses (Barrios, Guillerman, Kirby, and Linkins 2008). Senator Barack Obama seems to have benefitted the most from the increase in youth voter participation during the 2008 primaries, since he was the clear choice among Democrat voters 18 to 29. Sixty percent of that group supported Obama while his close contender, Senator Hillary Clinton, received 38 percent. The young Republican support was more evenly divided among their candidates (Barrios et al 2008).

The overwhelming support of the youth for Barack Obama is seen by taking a look at all the districts he won during the 2008 presidential primaries where he obtained victory in most of the cities where there was a major university (CNN Data). According to an article in Time Magazine about Obama's campaign, "His campaign has become the first in decades-maybe in history- to be carried so far on the backs of the youth" (Von Drehle 2008). Obama started the 2008 television ads aimed specifically at Iowa students (Von Drehle 2008). Political campaigns should try to follow the example that Obama's campaign has shown and make a serious effort to obtain the support of the youth vote. The increase in youth voter participation is significant compared to other years. Candidates, particularly Obama, hope to see this increase reflected in the November Presidential Election.

The Benefits of Increasing Young Voters Turnout

The first group that will benefit from increasing youth voter turnout is the youth group itself. Oshyn and Wang (2008) address the problem that the issues and views that matter to the youth are not being truly represented by public officials. Young people need to participate in the political process every election to force candidates and politicians to pay attention to their needs and concerns. As a result of the lack of participation over the past election cycles, young adults are being represented by politicians who pay more attention to older generations because not enough of the young are voting (Oshyn and Wang 2008). Young Voter Strategies reports that in 2008, the millennial generation (18 to 31 years of age) will be close to 50 million, nearly a quarter of the electorate. Young people need to vote and choose their candidates so that American democracy can be more representative of its population (Oshyn and Wang 2008). For both authors, the youth vote is important as a matter of enfranchisement of this particular group.

The youth should be the group that benefits the most from increasing its own partici-

pation in elections. However, political parties and campaigns can also gain something from appealing to young voters. A report by Young Voters Strategies indicates that party identification develops early in adulthood, since it is a time when partisan leanings are forming. According to the report, young adults are ripe for outreach from political parties and organizations. The report by Young Voter Strategies includes information from the political scientist Norman J. Ornstein, who in 1986 tracked the rise and falls of America's political parties and found a remarkable trend. Ornstein found that the party that wins the youth vote is a generation later the party in power. Young Voter Strategies points out that Ornstein's theory had evidence of being true since in 1984 and 1988 Republicans won the youth vote.

As a result, those young voters are now the middle-age core of the Republican Party. The report states that twenty years later, those "youth voters" are in their 40s and still voting Republican (Young Voters Strategies, 2007). The Republicans took advantage of the support they obtained from the youth in the eighties to gain an advantage over the Democrats during the Republican revolution in the early 1990s when Republicans secured and kept, until 2006, a stronghold in Congress (Young Voters Strategies, 2007). The Democrats have won the youth vote over the last two election cycles and if they keep investing in this group they have a great chance to win the majority of the 42 million 18 to 29 year old citizens. According to the NYT/CBS News/MTV Poll, current voters are leaning democratic with over half of respondents between the ages of seventeen to twenty nine years old stating that they plan to vote for the Democratic candidate in the 2008 presidential election. The importance of the youth vote for both political parties is not only clear in the present, but also an investment for their future.

The importance of the youth vote is found in the potential of its great numbers which, if a majority of them vote during elections, can influence the results. For political parties and organizations, the main goal should be to find what are the main issues or motivations that drive young people to be politically active. To have a better understanding of what drives young people to be involved in campaigns there is a need to look at research that explains some of the reasons why young people do not get involved in politics and particularly in elections.

Literature Review

Although the results from the 2004 Presidential Election showed an increase in voter participation in the youth voter turnout, that increase did not go over 50 percent. Older citizens have a more constant level of political participation than young people. This has always been so, due largely to the less settled and still developing (economically, educationally, politically, socially, etc.) nature of younger citizens. What is dangerous for our democratic system is the current pattern of civic disengagement in which nonvoting young citizens are growing into disengaged older citizens (Kaid, McKinney and Tedesco 2007). Research indicates that the concern about low levels of political participation among young voters may be conjoined with one characteristic. Young voters sometimes show a shockingly low level of political knowledge (Kaid et al. 2007). Research suggests there is a strong relationship between young voters' perceptions or confidence in their political knowledge and the possibility they will practice their right to vote.

In their own work on citizen engagement in 1996 and 2000, Kaid, McKinney, and Tedesco learned that one of the principal reasons given by young citizens to explain their nonvoting behavior is their perceived lack of knowledge about the candidates and issues. The authors listened to thousands of college students in focus groups conducted by their research team at different locations throughout the United States in 1996 and 2000. One of the most repeated answers college students gave to explain their electoral abstention

was that they lacked sufficient knowledge to participate as an informed voter (Kaid, McKinney, and Tedesco 2000). By studying how a young citizen's lack of knowledge may act as a barrier or "demotivator" to electoral participation, the authors found links between the notion of general political efficacy and what the authors termed, political information efficacy. This theory serves as the first explanation why young people get involved in politics, when they feel sufficiently knowledgeable about political issues. The authors' theory of political information efficacy states that different levels of information processing occur from various sources of political information. Their research also showed that users of the Internet, National Public Radio listeners, and news magazine readers proved to be most knowledgeable about political campaigns as measured by correct answers to current campaign news (Kaid et al. 2007).

Research conducted by the authors Esser and de Vreese (2007) adopts a comparative perspective in their study to identify the factors that might help reengage the youth in the political process by documenting the scope and pervasiveness of the problem in the United States and the European Union. The authors found a strong and consistently positive effect of news media use and interactive communication online on youth turnout (Esser and de Vreese 2007). A second explanation to understand why young people are politically active is to look at their socioeconomic background where several factors play an important role, such as gender, educational qualifications, and social class. According to Esser and de Vreese, young women have become more likely to vote than young men. In the 2004 Presidential Election 52 percent of young women participated in the election compared to 45 percent of young men. However the education gap is more significant in the United States. In 2004, turnout among college educated individuals 18 to 29 year olds was almost twice as high as among less educated youth. Higher educated individuals, those with some college education, have consistently been twice as likely to vote as those who have received no more than a high school diploma. In 2004, 61 percent of college educated young people voted while only 34 percent of non college educated participated in the election (Kirby et al 2005).

Esser and de Vreese show that the years between 18 to 29 years old are critical to young people developing the civic identities and voting habits that they will take with them into adult life. Their study was designed to provide a cross-national perspective on youth participation in elections. They found that variables on the individual level were of the utmost importance. For example, factors such as high socioeconomic status and attitudinal factors such as partisanship and political interest are positively related in both the United States and the European Union. This finding allows researchers to generalize that apathy, a lack of interest in politics, and a feeling that "no one party stands for me," also identified as a lack of partisanship, are severe threats to young people's electoral participation across many mass democracies (Esser and de Vreese 2007). Other research focuses on the role of candidates and politicians. As mentioned earlier politicians do not address issues that affect young people so young adults believe that politicians do not recognize their issues; and thereby do not participate in elections.

The study by Wells and Dudash reports findings from a national focus group investigation that sought to understand young voters' information seeking habits. Their analysis identifies where young voters get their political information, what they do with this information, and whether greater knowledge leads to increased feelings of political efficacy and participation. The authors believe that understanding young citizens' information seeking habits might point out to specific ways for promoting more informed, and engaged young voters (Wells and Dudash 2007). According to the focus group, young citizens deemed presidential debates as credible sources of information since there is no middle person between the candidate and the young voter. Network news are not an

entirely credible source to young people, especially if serving as the only outlet for information. The most credible source of news for young citizens seems to be international sources and those sources not controlled by American corporate news networks. Outside sources like National Public Radio or the British Broadcasting Network are favorites of young citizens. Young citizens believe that American corporate news networks have different political bias so they end up relying on radio and foreign news to get poltical information (Wells and Dudash 2007).

The authors found equally important that many young voters recognized that they obtained a great deal of their political information from entertainment sources such as Jon Stewart's "The Daily Show" or late night venues like David Letterman and Jay Leno. Yet frequently when an entertainment source was mentioned, the young voter would almost apologize for utilizing this source or confess to its questionable credibility (Wells and Dudash 2007). Some participants voiced different opinions about the credibility of the Internet as a credible source. When young people participating in this focus group were asked to name the major sources where they obtained political knowledge they gave several answers. The seven political information sources named the most were discussion or talk, Internet, cable news, newspapers, radio, local news, and campaign advertisement. Discussion or talk and the Internet were the most popular. Most respondents in their discussions indicated that they possessed sufficient knowledge to participate effectively in the political process. Several participants suggested that their exposure to often conflicting information left them uncertain about the candidates and issues and unclear as to how they could use this knowledge to engage the political system (Wells and Dudash 2007).

In addition, young students perceived presidential debates as important since it is their opportunity to hear the candidates argue with one another about their positions on different issues. Wells and Dudash's research showed that young citizens deemed presidential debates as a credible source of political information. There is other research that studies the influence presidential debates have over young people's perceptions of candidates. Robert H. Wicks (2007), exposed college students to the final 2004 Bush-Kerry televised presidential debate. According to Wicks, scholars assert that debates can be important on close races since people evaluate candidates on the basis of issues presented and feelings toward the candidate. McKinney and Chattopadhyay (2007) have also researched the influence of presidential debates on young citizens. The authors' findings reveal that debates strengthen, in short term, democratic attitudes and young citizens' levels of political information efficacy.

The authors hold debates as one of the most information-rich sources of campaign information since they offer significant exposure (approximately 90 minutes) to issues and candidate-image information (McKinney and Chattopadhyay 2007). The authors reported that young citizens' political efficacy increased following the debate exposure; however, debate exposure had little effect on young citizens' trust in politicians. When examining the pattern of attitude change across time, and particularly change in attitudes from post-debate to post-election, the authors found that young citizens actually lost any beneficial effects they had acquired from their debate exposure. The authors' findings suggest that a presidential debate provides an effective campaign message for enhancing young citizens' democratic attitudes and strengthening political information efficacy (McKinney and Chattopadhyay 2007).

Another area of research focus on the influence of factors such as political and social issues which play a role in driving young people to be active in politics. A poll conducted by the New York Times, CBS News and MTV during June 2007 revealed important information about the main issues that concern young voters during this presidential year. When the young citizens were asked to name the important issues facing their generation,

Methodology

Using interviews, a case study approach was adopted by the researcher to study and compare the experiences in politics of several young people who were politically active during the past democratic primary in Texas. The interviews were conducted face-to- face or over the phone. As mentioned earlier, Senator Barack Obama seems to have been the candidate who benefitted the most from the increase in youth voter participation during the 2008 primaries since he was the clear choice among Democrat voters 18 to 29. Sixty percent of that group supported Obama, while his closer contender, Senator Hillary Clinton, received 38 percent. The young Republican support was more evenly divided among their candidates (Barrios et al 2008). According to different polls, including the New York Times Poll, Senator Obama enjoyed the vast majority of the youth vote and Senator Clinton was his closest second. For this reason the interviews were focused on young people who were active in the Democratic primaries, particularly with the Obama campaign or Clinton Campaign. The students chosen to be interviewed were only from the democratic party because the interviews took place during the summer and only students who worked for the democratic candidates were available. However, in future research young students who have been involved in the republican primaries and presidential election will be interviewed.

The participants were picked for this research for having been politically active during the campaign. Three Hispanic students and one African-American student participated in the research. They were asked to describe their involvement in the political campaigns during the primary and what motivated them to become active. The interviews took place between July and August. Two students were active in Senator Clinton's campaign. The Clinton supporters campaigned for her in Phoenix, Arizona. The other two students campaigned for Senator Barack Obama in San Antonio, Texas. Their answers will be compared to each other to confirm if there are issues or motivations that are considered important more than others. The interview instrument was devised by the researcher and a mentor who together created the questions being used during the interviews. The researcher expects to find similarities among the responses but there are expectations that some may vary depending on the declared major of the student, or ethnic background.

Preliminary Results

Four students from St. Mary's University who were politically active during the primary season were interviewed by the researcher. Three of the students had originally been Senator Clinton supporters during the primary season and the other supported Senator Obama. After Senator Obama was declared the winner of the Democratic primary process in June 2008, two of the students supporting Senator Clinton made the transition to support Senator Obama while one declared himself undecided for the November Election. One of the students supporting Obama in the November election strongly felt that Senator Clinton was the better candidate with more experience. Based on their responses during the interview, two students strongly supported Senator Obama because they considered him a charismatic public personality. Another student supported Senator Obama out of party loyalty, and issues such as Supreme Court appointees. The researcher expects that comparing and contrasting the student's answers to the ideas and theories exposed in the literature review will provide an insight to what motivates young people to be politically active.

All four participants have been involved in political campaigns for the Democratic party since they were in high school, or middle school. The participants mentioned that their parents were also politically active, and they had taught them the importance of voting and participating in the political process. Their knowledge of political information

serves as a good indicator of their interest in participating in the political process. When asked where they got their political information, the four students mentioned they follow different media outlets such as news networks, Internet, and newspapers. They agreed that most media outlets showed bias toward one party or the other and they preferred international outlets such as the British Broadcasting Corporation (BBC).

According to the students, the top issues the next president has to deal with are Iraq, the war on terror, the economy, education, health care, immigration, diplomacy, and gas prices. Not surprisingly, their responses were similar to those given by the young people in the New York Times/CBS News Poll. When asked about the lack of involvement of the youth during past elections, the students answered that many young people are caught up in college and a social life, pursuing their own agenda. As a result, these young people do not see the point in voting and feel their vote is not important. One student mentioned that the youth are not sufficiently informed about candidates and political issues; thus, they are not confident to vote. The students proposed that to get the youth more involved in political issues, there is the need to educate them in the process of voting. Political education is a priority to help students understand the issues important to the nation.

The influence of demographic or ethnic factors appeared when Hispanic students mentioned the importance of immigration reform while an African-American student mentioned the importance of race being brought up to the forefront of American politics. These answers reflected the ethnic, racial background of the students participating in the interviews. Race is still part of the motivations and issues that drive young people to be politically active. The four students were dependent on their families; the differences in their income levels reflected certain diverse opinions about the economy. The student who had experienced unemployment in his family had strong opinions about government providing job security. The students whose families registered an income of $60,000 or more did not go into too much detail about the issues of government providing jobs for the citizens.

Conclusion

The number of students participating in the interviews was small. However, they provided preliminary findings that reflect the results in polls with bigger samples. According to the theories explored in this study, the main issues that influence the youth when it comes to voting is their perceived level of political information. Many young people feel they are not educated enough to make the right decisions about who or what to vote for. The students agreed that there is a need to educate the American youth to increase their political participation. The students from St. Mary's University agreed that issues such as the economy inspired them to be active in this election year. There is a need to do further research to better understand what the motivations that drive young people to participate in elections. Political campaigns need to invest more time educating and attracting the youth so they can obtain the support of this voting sector.

Senator Clinton and Senator Obama already invested time in attracting the youth. Senator Obama had great success in this enterprise as indicated by CNN information which showed that Senator Obama won most of the districts that included major universities. The purpose of this study was to explore the issues and motivations that drive young people to be politically active. There is a need to do further research into what motivates young people to be active in politics. Future research should include young people who have involved in the republican primaries. The presidential election should motivate more young people to get involved in politics and this situation will help this research to move further with more interviews from both sides, democrat and republican. Having both views will increase our understanding of the reasons why young people get involved in

politics. A key part of democracy is to keep the youth interested and involved in politics at an early age and maintain young people's level of political information efficacy during future elections.

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