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EDITOR'S INTRODUCTION

The Wagner Forum for Undergraduate Research is an interdisciplinary journal which provides an arena where students can publish their research. Papers are reviewed with respect to their intellectual merit and scope of contribution to a given field. To enhance readability the journal is typically subdivided into three sections entitled *The Natural Sciences*, *The Social Sciences* and *Critical Essays*. The first of these two sections are limited to papers and abstracts dealing with scientific investigations (experimental and theoretical). The third section is reserved for speculative papers based on the scholarly review and critical examination of previous works.

This issue also includes select abstracts from the Eastern Colleges Science Conference which is the largest undergraduate research conference in the United States.

Read on and enjoy!

Gregory Falabella and Richard Brower, Editors

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Section I: Eastern Colleges Science Conference

Comparing Intracardial Perfusion Fixation and Immersion Fixation in the Adult Zebrafish Brain Ultrastructure[1]

Letizia M. Hobbs (Microbiology), Vincenzo DiMaggio (Microbiology MS Program), Christopher Corbo (Microbiology MS Program), Prof. Linda Raths (Biological Sciences) and Dr. Zoltan Fulop (Biological Sciences)

It is widely accepted that when studying the morphology of the brain at the electron microscopic level, intracardial perfusion is required to maintain the brain's delicate ultrastructure. This procedure, which is easily performed in mice and rats, is not as easy to accomplish in the zebrafish. Due to the small size of the brain, immersion fixation is easier and may be sufficient since the fixative does not have to penetrate as deep as it would in a higher vertebrate. For this study, a self designed perfusion apparatus was used and user proficiency was maximized. Zebrafish brains were either exposed and fixed by immersion in situ or perfused. Immersed brains were fixed in situ overnight, then removed from the skull and post fixed for another whole day. Perfused brains were post fixed one whole day after a 15 minute perfusion. The brains were fixed using Karnovsky's fixative, post fixed with osmium tetroxide, dehydrated through increasing concentrations of ethanol and embedded in plastic resin. Semithin sections were cut and stained with tolludine blue and the perfused brains were checked to be sure that the blood vessels were clear. Ultrathin sections were cut and stained with uranyl acetate and lead citrate then compared using transmission electron microscopy. When studying under the TEM, it is evident that the perfused brains were fixed more thoroughly. This can be seen when comparing the ultrastructure of the cell membranes and organelles such as the mitochondria. Although the size of the brain is considerably smaller, the immersion fixation does not yield as high a quality fixation as intracardial perfusion. This is most likely due to the quick degeneration of brain tissue after death.

Integrating Materials Science into Middle School Science Programs

Kimberly Farrell (Chemistry) and Racquel Campo (Chemistry)[2]

Integrating a student's science education with lessons and hands on experiments, not included in the school's textbook, is an essential component of the learning process. This objective was manifested into an ongoing research project based on materials science

[1] Recipient of Excellence Award for Student Presentation in Animal Biology
[2] Research conducted under the supervision of Dr. Wendy deProphetis (Chemistry)

through the mentorship program between Liberty Science Center scientists/educators and the Wagner College research team. In collaboration with Picatinny, a pre-eminent national and international leader in the research, development, engineering and production support for advanced weapons systems, several activities have been developed, which encompass various topics of materials sciences. The task of the Wagner College researchers was to establish these new activities according to a 45 minute lesson plan for middle school students. These activities were designed and mapped to incorporate national and state standards. The scientists, researchers, and educators from LSC critiqued each lesson and improved upon them during teacher training workshops. Once the activities were finalized, LSC placed us in middle schools throughout New Jersey in order for the activities to be implemented in a classroom environment. The assessment forms received from Liberty Science Center, by both student and teacher, have confirmed that materials science is an interesting area of science, which is not given enough focus in a school's science program.

Duplications, Position Effect, and the Phenotypic Changes Associated with Bar-Eye Mutations in Drosophila Melanogaster

Irena De Mario (Biology) and Dr. Ammini Moorthy (Biological Sciences)

Drosophila melanogaster shows a semi-dominant X-linked mutation called the Bar-eye. The Bar mutation reduces the number of facets and causes an alteration in the shape of the compound eye due to a duplication along the X chromosome of region 16A1-16A7. Genetic studies have shown that this duplication is present within Bar mutants, but that there is a triplication in double and triple Bar mutants. Furthermore, the mechanisms of position effect and unequal crossing over in double and triple Bar mutants alter the phenotypic change in the eye due to the placement of the triplicated regions. When the three regions are situated on the same homolog, a triple Bar fly results. However, when the regions are positioned on two homologs, a double Bar fly is produced. Images generated from the scanning electron microscope provided an ideal way to observe the differences in the phenotypes of wild-type, Bar, and double Bar flies and to correlate them with the genetic mechanisms. The results revealed that wild-type flies contain 748-778 facets, Bar mutants have 354-380 facets, and double Bar mutants possess 43-64 facets. These facet numbers for the wild-type, Bar, and double Bar flies were consistent with published data of 779, 358, and 68 facets, respectively, for each of these fly types. In addition, the results indicated that two samples from the double Bar flies with facet

numbers of 43 and 48 could have been triple Bar flies, since double Bar flies can mate and produce a triple Bar mutant. These two samples had facet numbers that matched documented data of 45 facets for the triple Bar flies more precisely. Therefore, the research showed how the Bar mutation has its effect on the phenotype through genetic mechanisms, such as duplication, position effect, and unequal crossing over.

A Statistical Analysis of the Standard & Poor's 500 Index

Maris Reutzel (Physics)[3]

Standard and Poor's is a financial company devoted to portraying the numerous dimensions of the financial industry and the necessary information that the general public require to make sound investments. The Standard & Poor's 500 Index allows the public to follow a wide array of stocks in the market and is therefore an optimal choice to follow and analyze to comprehend the rise and fall of the stock market. Through mathematical analysis I will show that the Standard & Poor's 500 Index over a segment of time will portray a normal curve. Understanding the standard deviation and normal distribution of the data for the S&P 500 Index provides investors and portfolio managers the benefit of comprehending the risk-reward relationship.

Jury Bias: The Effects of Race, Sex, and Physical Attractiveness on Jury Sentencing

Elicia Enriquez (Psychology) and Dr. Amy Eshleman (Psychology)

Physical descriptions heavily influence people's impressions of others. When meeting someone for the first time, people judge others within the very first seconds of coming into contact. This judgment is not based on a target's personality but solely based upon physical characteristics. The purpose of this study was to determine the influence of race, sex, and physical attractiveness on jury sentencing and to find if these three characteristics, either together or separately can sway a juror's decision to convict or release a criminal. Undergraduate participants were given a crime report along with a randomly assigned photograph of a perpetrator. In a 2 {gender} X 4 {race} X 2 {attractiveness} design, each participant viewed one of 16 photographs: male or female; Black, White, Asian, or Hispanic; physically attractive or not physically attractive. Participants were instructed to imagine being on a jury and to decide whether or not the

[3] Research conducted under the supervision of Dr. Otto Raths (Physics)

suspect was guilty of the crime and, if guilty, to choose an appropriate punishment. The levels of punishment ranged from lenient, including community service and psychiatric care, to harsher punishments, including fines and varying levels of jail time. Based upon theories of systematic racism and benevolent sexism as well as the what is beautiful is good hypothesis, it was hypothesized that an attractive White female would receive the most lenient sentence while an unattractive Black male would receive the harshest punishment. Results will be reported at the conference. Theoretical considerations consist of in depth analysis of jury sentencing, focusing on the impact of first impressions and considering the effects of race, sex, and physical attractiveness on jurors' decisions. Potential applications for this research include more detailed screening tests for jurors, which examine gender and racial biases, and educating jurors on the possible influences of physical characteristics.

Hydrothermal Crystal Growth of ZnO

Jennifer Hart (Physics) and Dr. Maria Gelabert (Chemistry)

The chemistry of aqueous zinc solutions was explored to see the effect on size and morphology of zinc oxide crystals. Ethylenediaminetetraacetate and pentaethylene-hexamine were used as chelating ligands for Zn^{2+} in the growth of ZnO crystals. In this study, complexing agents and pH were varied in the precipitation of ZnO from basic aqueous solutions. Autoclaves were used for synthesis at 200^{o}C and around 15 atm. Optical microscopy on the resulting products revealed crystals of varying size and morphology. The variation in size and morphology will be discussed in terms of changing pH, molality and ligand identity.

Crossing the Burning Sands: A Social Psychological Investigation of Hazing

Christianna Gozzi (Psychology) and Dr. Amy Eshleman (Psychology)

Hazing, the initiation rituals of many national Greek social organizations, has resulted in extreme harm, including hundreds of deaths, in its long standing tradition. Researchers have found that the more severely an individual is initiated into the group, the more the individual reports liking for that group. In order for individuals to be integrated into a group, they must feel that they are an important asset to the group and must perceive the group as attractive and valuable. The current study predicts that participants who believe that they have been specially chosen to participate in the study and who partake in a

bonding activity will report more liking for a group than those participants who were neither specially selected nor bonded to their peers. As part of a 2 X 2 design, undergraduate students endured a simulation of a severe initiation under circumstances which ethically simulated Greek pledging traditions. The independent variables were operationally defined as bonding of groups v. no bonding and specially chosen by researcher v. simply signing oneself up for the experiment through the online participant pool. The first of two initiation conditions; the mild initiation procedure was a campus wide scavenger hunt. In the severe condition, participants were blindfolded and asked to creatively describe unusual combinations of common household products. The participants were randomly selected to complete these tasks as a group or independently. All the participants perceived that their performance in both tasks was contingent upon admission into an attractive group of confederates posing as upperclassmen researchers. The dependent variables included time to complete the scavenger hunt and self reported liking for the group. The goal of the current study is to define the necessary elements for initiation and positive non-violent alternatives to hazing. Results of the experiment will be presented.

Racial Bias: Do We Love Ourselves or Just Hate Everyone Else?

Daniel Bryant (Psychology)[4]

A study was conducted to examine motivations for intergroup bias. It was hypothesized that intergroup bias is primarily motivated by either a positive feeling for an in-group or a negative feeling for an out-group. To evaluate which of the two it is, White American college students were shown a list of crimes committed by two hypothetical male criminals and were randomly assigned to one of four groups. The first group viewed mug shots of two White American individuals, the second group viewed mug shots of two Black American individuals, the third had one White American and one Black American individuals' mug shots, and the control group had no pictures. The participants were asked to assign each hypothetical criminal a number of years for which he should be incarcerated. Results of which group received the highest mean punishment was presented at the conference. By having a control group for comparison to the others as well as performing a manipulation check for the control group, to see if control participants pictured a race for the hypothetical criminal, longer sentences for Black

[4] Research conducted under the supervision of Dr. Amy Eshleman (Psychology)

American criminals will indicate an anti out-group bias while lower sentences for White American criminals will indicate a pro in-group bias. By understanding motivation for racial intergroup bias we may be able better understand how to treat the problem. Pro in-group bias may suggest a need for better integration while anti out-group bias may suggest a need for sensitivity training or something similar.

Virtual Screening and Identification of Small Molecule Inhibitors of the Melatonin Rhythm Enzyme

Margarita Javoroncov (Biology and Chemistry), L. Szewczuk (Johns Hopkins University School of Medicine, Department of Pharmacology), Dr. Surajit Ganguly (Johns Hopkins University School of Medicine, Department of Pharmacology), Dr. S.A. Saldanha (Scripps Research Institute, Department of Molecular Biology), Dr. R. Abagyan (The Scripps Research Institute, Department of Molecular Biology), and Dr. Philip A. Cole (Johns Hopkins University School of Medicine, Department of Pharmacology)

Melatonin is a serotonin derivative produced in the pineal gland of all animals and the retina of mammals. It modulates a wide assortment of circadian cycle pathways, especially those concerning sleep and mood. The biosynthetic pathway for the conversion of serotonin to melatonin is determined by the concentration of arylalkylamine-N-acetyltransferase (AANAT, serotonin N-acetyltransferase) in the pineal gland and retina. The active sites of AANAT include those for arylalkylamines and acetyl-coenzyme A. A series of competitive small molecule inhibitors were selected from 1.2 million commercially available compounds via Internal Coordinate Mechanics (ICM) virtual ligand screening. The compounds chosen came from Sigma/Aldrich rare chemicals (Salor Collection) and the National Cancer Institute repository. Virtual ligand screening, based on the energetics of ligand binding and variation of a coupled enzyme spectrophotometric assay, was utilized to determine the inhibitory activity of each compound. Compounds that significantly inhibited AANAT were subjected to a doubling of the coupling enzyme. Additional spectrophotometric enzyme assays were run observing AANAT activity in the presence of nonionic detergent to investigate the possibility of protein aggregation and a dose response curve was generated for decreasing amounts of inhibitor. A radioactive assay was utilized to confirm AANAT activity in the absence of a coupling enzyme. Electrospray mass spectroscopy assured the presence of the predicted inhibitor. Seven compounds were found to inhibit AANAT. These small molecule inhibitors may be utilized for drug design due to their moderate potency and non-toxicity.

Cloning jadR1 -jadR2 Intergenic Region of Jadomycin Biosynthesis Cluster in Streptomyces Venezuelae

Yevgeniy Statnikov (Microbiology) and Dr. Roy H. Mosher (Biological Sciences)

Streptomyces venezuelae ISP5230 is a filamentous, Gram-positive soil bacterium that produces chloramphenicol and the polyketide-derived antibiotic jadomycin B (JadB) when grown under nutrient-limiting conditions. However, S. venezuelae only produces JadB when exposed to an additional environmental stress such as heat shock or toxic levels of ethanol. Two regulatory genes, jadR1 and jadR2, that are divergently oriented and adjacent to each other on the S. venezuelae chromosome have been identified. The 651-bp intergenic region that separates jadR1 and jadR2 is predicted to encode promoter sequences essential for controlling the expression of both genes. To better understand the regulation of jadR1 and jadR2, we propose to subclone the intergenic region by inserting it into the promoter probe plasmid pXE4 and then introducing the resulting recombinant plasmid into S. venezuelae. To accomplish this goal, the intergenic region has been PCR amplified using pJV70A as a template and oligonucleotide primers that generate BglII and HindIII sites at either end of the amplicon. The identity of the resulting amplicon was confirmed by digesting with BamHI, which generated the expected 504-bp and 165-bp products. We plan to clone the amplicon by digesting it with BglII and HindIII and then ligating it to HindIII/BamHI digested pXE4.

The Effects of Varying Ethyl Alcohol Concentrations on Zebrafish Development: A Morphological Study

Lauren Maltese (Biology), Christopher Corbo (Microbiology MS Program),
Prof. Linda Raths (Biological Sciences), and Dr. Zoltan Fulop (Biological Sciences)

Fetal Alcohol Syndrome is a disease caused by the consumption of alcohol during pregnancy. The effects of prenatal alcohol exposure often result in teratological features including facial abnormalities and central nervous system dysfunction. This experiment was performed in order to build upon previously reported data, testing if the teratological effects were evident in the developing zebrafish. The focus of this study was to characterize the cellular events during the development of the zebrafish brain. Eggs were collected right after fertilization and housed in 0.05%, 0.08%, 0.1%, and 0.5% ethyl alcohol concentrations and as control groups. Macroscopic morphological malformations were observed throughout each alcohol concentration and photographed. Every two days, beginning with the newly hatched embryo (4 days post fertilization), fry were fixed using

Karnovsky's fixative, post fixed in osmium tetroxide, dehydrated through increasing ethyl alcohol concentrations, and embedded in plastic resin for light and electron microscopic observation. Plastic embedded sections of the brain were cut and stained for both light and electron microscopic analysis. Based on this study, it is evident that alcohol exposure has detrimental effects on the development of the embryos, especially in the developing brain. Due to their transparent chorion, ease of breeding and ease of maintenance, zebrafish are a very strong model organism for studying fetal alcohol syndrome.

Activation of Microglial Toll-like Receptors Increases Uptake & Degradation of Amyloid Beta in Vitro[5,6]

Emily Babcock-Petrus (Biology), Daniel Kerr (Institute for Basic Research), Dr. George S. Merz (Institute for Basic Research) and Dr. Daryl Spinner (Institute for Basic Research)

Alzheimer's Disease (AD) is a fatal neurodegenerative disease, which affects learning, memory, and speech. An important event in the progression of this disease is the accumulation of amyloid beta (A) peptides, which leads to the deterioration of brain tissue. Glial cells such as microglia are thought to play an integral part in the clearance of this harmful material, however during AD these glial cells function too slowly to impact the rapid spread of the peptide plaques throughout the brain. Identifying a mechanism that would enable microglia to work faster and more effectively in the clearance of A material would be an ideal way to fight the progression of this fatal disease. Toll-like receptors (TLRs) are transmembrane proteins, which enable the immune system (including glial cells) to become phagocytic and responsive to harmful material such as A plaques. By employing agonists for TLRs located on microglia, their effectiveness in clearing A plaques could be increased, resulting in less neural damage over time. This study examined the effect of microglial exposure to agonists specific for TLRs 2, 3, 4, 5, 7, or 9 with regard to A clearance in vitro; ligands that target these TLRs include Pam3CSK4, poly [I:C], lipopolysaccharide, flagellin, ssRNA or CpG DNA, respectively. These agonists were incubated with the cells for 24 hours prior to a 20 min exposure to aggregated FITC dye-labeled A1-42 material. Cells were immunolabeled and analyzed using confocal fluorescence microscopy. All agonists increased the uptake and clearance of A by microglia versus untreated controls. Furthermore, the treated cells were

[5] Recipient of Excellence Award for Poster Presentation in Cell Biology
[6] Recipient of Excellence Award for Full-Length Paper

able to completely degrade the neurotoxic material within 24 hours. These results suggest that TLR agonist treatment is an effective method to increase microglial A plaque-clearing activity, and could be an important part of future therapies for AD.

The Relationship between Perfectionism and Sleep Difficulties

Laura J. Kohberger (Psychology) and Dr. Steve M. Jenkins (Psychology)

Previous research suggests that sleep difficulties are more common among college students than in the general population, with approximately one-third of college students reporting common or chronic sleep difficulties. Many college students demonstrate perfectionistic tendencies including rumination, unrealistic self-expectations, excessive fear of criticism by others, and high levels of arousal. It is possible that these tendencies may exacerbate or be the underlying cause of sleep difficulties in some individuals. The current study examines the relationship between perfectionism and sleep difficulties.

Rhodococcus equi: Spore or Non-Spore Former?

Michael Bois (Microbiology), Mouhammed Halwani (Microbiology),
Edmond Kurtovic (Microbiology), Dr. Kathleen Bobbitt (Biological Sciences)

Rhodococcus equi is a facultative aerobe, gram positive, pleomorphic coccobacilli. It is commonly found as the causative agent of pneumonia in foals, but also affects immuno-compromised individuals. The research conducted involves R. equi and its ability to form spores. A culture of R. equi was grown on a highly selective media called Trimethoprim-Cefoperazone-Polymyxin B (TCP). The bacterium then underwent comparison against other organisms that it is related to, as well as displaying certain attributes, which were vital to its understanding. Both R. equi and Streptomyces venezuelae were grown on Glucose Salts Media in order to see whether or not a color change would occur due to the presence of spores. R. equi, Mycobacterium phlei, Coreynebacterium xerosis, Coreynebacterium pseudodoptheridicum, and Bacillus subtilis were subjected to 70% EtOH in intervals of 5, 10, and 15 minutes. They were then plated and growth was compared. M. phlei, C. xerosis, and C. pseudodoptheridicum were selected due to their thick cell wall which would possibly allow them to survive in these conditions. B. subtilis was used because of its ability to sporulate, which might allow it to survive. Following these tests, samples were collected of Staphylococcus aureus, B. subtilis, R. equi, C.

pseudodoptheridicum, M. phlei, C. xerosis, as well as Rhodococcus rhodochrous. These samples then underwent processing for Transmission Electron Microscopy, Scanning Electron Microscopy, and Light Microscopy to compare their internal and external cellular features. It was found that R. equi had internal structures that resembled spores. Following this, a standard spore stain yielded a small amount of spores. Acid hydrolysis spore staining will be done in order to enhance the staining of the
spores. A growth curve for R. equi will also be done. At each growth phase, TEM processing of the sample will be done to evaluate at what time the bacterium sporulates.

Effect of Various Ethanol Concentrations on the Shoaling Behavior of Zebrafish (Danio Rerio)

Anastasia Kurta (Biopsychology)[7]

It has been predicted that fish should prefer to shoal (school) with similar individuals, as an adaptation to avoid predation via the confusion effect. Zebrafish (Danio rerio) shoaling was studied via observations of groups of four fish, divided by gender and subjected to four different ethanol (EtOH) concentrations. In the past ethanol has been shown to have hormetic effects at low level doses, affecting behavior of many organisms. All of the observations were recorded every 2 min using a camera connected to a computer, and with each trial lasting a total of 12 min. Nearest neighbor distance between each fish, as well as the shoaling area, were quantified and compared between each concentration. Analysis of 1.0% EtOH concentration has indicated to have inhibitory effects on behavior in comparison to the control. Preliminary results also suggest that shoaling is tighter than in the control at lower concentrations.

The Effect of Caloric Density on Conditioned Taste Preferences of Caffeinated Beverages

Alfred Raccuia (Biopsychology) and Dr. Laurence J. Nolan (Psychology)

Learning through Pavlovian conditioning significantly contributes to an individual's liking for food and drink. This type of learning is known as conditioned taste preference, and it is known that in humans conditioned preference is influenced by the caloric density of the food or drink in question. Furthermore, caffeine is a weak positive reinforcer, with mild psychoactive effects. Through its ability to act as a negative reinforcer, people can

[7] Research performed under the supervision of Dr. Brian Palestis

be conditioned to prefer the taste of caffeine. The question of whether greater caloric density of the drink produces stronger conditioned taste preference in caffeinated beverages has not been addressed. The aim of the present study was to determine whether caloric density has an effect on the production and degree of conditioned caffeine taste preference. The study included four groups: caffeine and sugar, caffeine and Splenda, no caffeine and sugar, and no caffeine and Splenda. Pleasantness ratings of the groups were compared.

Section II:
The Natural Sciences

Invention and Application of a Stereotaxic Apparatus for Adult Zebrafish Brain Surgery[1]

Letizia M. Hobbs (Biology)[2], Edmund C. Jenkins ((Microbiology MS Program), Christopher P. Corbo (Microbiology MS Program), Prof. Linda Raths (Biology) and Dr. Zoltan Fulop (Biology)

The use of zebrafish (*Danio rerio*) as a laboratory animal has increased in recent years. Fish brains are known to have a high regenerative capacity---even during adulthood. This regenerative nature of fish brains makes zebrafish an excellent model to study brain regeneration and recovery following a traumatic brain injury (TBI). However, zebrafish have not been used so far in TBI research. This might be due to the relatively small size of the zebrafish, as well as the difficulty of maintaining fish respiration during surgery. This study addresses these issues by creating devices and conditions to perform stereotaxic zebrafish brain surgery. A "holding and restraining plate" and "respiratory irrigating system" for zebrafish was fabricated, and mounted on Kopf's standard rat stereotaxic apparatus, a device commonly used in neurosurgery. Optimal anesthesia levels were determined and the survival rate of the zebrafish after surgery was evaluated. Post-surgical survival rates were found very high with optimal anesthesia. Our study suggests that this stereotaxic apparatus can successfully be used for adult zebrafish brain surgery.

I. Introduction

The use of zebrafish (*Danio rerio*) as a laboratory animal has increased in recent years. These small, hardy, freshwater fish from Southeast Asia have already significantly contributed to our understanding of different vertebral organs' structure and function (Detrich 1999, Henken 1998). There are distinct advantages in using zebrafish as a model organism. It is a vertebrate animal with a small body size (2-4 cm) that can be easily and inexpensively maintained in relatively small and confined spaces making experiments less expensive than using experimental animals with a larger body size which require more expensive housing. Zebrafish produce a large number of offspring

[1] The manuscript was sent in for competition at 61st ECSC and was awarded *Best Paper in Animal Biological Research*. It was then presented as a poster at the 39th Annual Fall MACUB Conference in New York, NY.

[2] Research performed and presented at Wagner College by the first author in partial fulfillment of the Senior Program requirements.

(about 200 eggs per day, everyday during several months of their reproductive period) and develop quickly (less than 6 months to reach sexual maturity) which make them popular experimental model organisms for genetic research (Knapkin 1998). Moreover, zebrafish development, including the nervous system, can easily be traced and manipulated through a transparent chorion. All these characteristics make the zebrafish conducive for neuro-developmental and neurological research (Zon 1999).

It is well known that fish brains have a high regenerative capacity---even during adulthood. This capacity of the adult fish brain makes zebrafish a potentially excellent experimental model to study brain regeneration and recovery after traumatic brain injury (TBI). Although the zebrafish has gained popularity in neuro-regenerative research in spinal cord injury (Becker 1998) and optic nerve crashing (Ballestero et al 1999), no research has been done in the field of TBI using this vertebrate animal. This absence of TBI research using zebrafish is likely due to its very small size as well as the difficulties associated with maintaining both the animal and its respiration during prolonged, open-air surgery.

This study focuses on how to overcome such experimental obstacles by creating the necessary devices and conditions required for zebrafish during stereotaxic brain surgery. Specifically, the study included the design, fabrication and testing of a "holding and restraining plate" and "respiratory irrigating system" suitable for the adult zebrafish to be used with Kopf's standard rat stereotaxic apparatus, commonly used in neuro-laboratories (Espejo 1997). The study device was then tested with different levels of anesthesia needed for a prolonged surgery that not only keeps the animal sedated but also allows the fish to survive after the surgery. Accordingly, the survival rate of the anesthetized fish after restriction in the study device was also evaluated. Secondly, a preliminary stereotaxic atlas of the adult zebrafish brain was prepared involving the measurement of the parameters of the zebrafish skull and the *in situ* brain after exposure. The measurements of the external markings were then transposed over the parameters of the brain.

II. Materials and Methods

Construction of the Stereotaxic Apparatus

The constructed "holding plate" complete with a "respiratory irrigating system" is described in the Results section.

Animals

Twenty-four adult zebrafish of either sex, obtained from local pet store, were used in this study. Animals were maintained in a regular, 120 L (about 30 Gallon) glass tank equipped with a normal tank filter. The water was stabilized at 27 °C, pH 7.2-7.4. The animals were kept in a room with a daylight and on a 14h:10h day/night fluorescent light cycle and fed twice a day with commercial flake food. This maintenance regimen followed the guidelines of Westfield (1993).

Restraining of Fish on the Stereotaxic Device for Prolonged Time with Short-term Anesthesia

Ten fish were anesthetized in 4% tricaine methanesulfonate solution (Tricaine) immediately before being mounted on the apparatus. Each animal was determined to be fully anesthetized if the fish no longer exhibited a flexor reflex when a pressure was applied to its tail for about one minute. Before being secured to the "holding plate," of the stereotaxic apparatus (Figures 1,2), different parameters of the fish were measured and recorded as follows: (1) weight (using Mettler Toledo PL303 scale); (2) length; (3) volume (using a fine scaled 10mL graduated cylinder the displaced water was recorded as the volume of the fish); (4) the time needed to position and secure the animal on the "holding plate".

Each zebrafish was secured at three specific points, their mouth and along their sides, in their natural position, resting on their abdomen (see details in the Results section and Figure 3). The mouth of the fish was pulled on a plastic tube that was connected to the “respiratory irrigating system.” The diameter of the tube was selected to closely fit the mouth of the fish allowing very little or no movement of the head, once secured. The sides of the fish were fixed with two wet sponges glued on "holding arms", designed to leave room for the gills to open and close during irrigation. Once properly oriented and fixed in the apparatus, each fish was held restrained and irrigated for a period of one hour. Pure tank water was used for irrigation. After one hour, the animals were removed from the apparatus and kept in isolation in normal tank water. Each animal's survival was recorded up to 14 days (Table 1).

Restraining Fish on the Stereotaxic Device with Long-term Deep Anesthesia for Surgery

In the previous part of this research we observed that the restricted zebrafish remained motionless until a noxious stimulus was applied. However, it moved vigorously when its tail was pinched or a tip of a hypodermic needle touched the skin. This fact clearly showed that a short-term anesthesia when applied prior to mounting on the apparatus was insufficient for surgery. A better anesthetic regime had to be

determined. The criteria for a better anesthesia were as follows: (1) a deep and long-lasting anesthesia was needed to perform surgery without causing pain to the animal; (2) the animal had to be returned to consciousness after surgery and survive for at least 14 days. This anesthetic regime was determined empirically. Briefly, the fish was first anesthetized in the 4% Tricaine solution prior to mounting then, 3%, 2% or 1% Tricaine solution, made in tank water, was continuously administered as irrigating respiratory solution to 3 different groups of fish. With this procedure, we aimed to determine the best concentration of anesthetics to maintain the fish irrigated for as long as it needed. The 3% and 2% Tricaine solutions killed the fish in a relatively short time, and accordingly were only tested on two animals per concentration. However, 1% Tricaine solution appeared to be appropriate and was tested on a total of ten fish (Table 2).

Composition of the Stereotaxic Atlas of the Adult Zebrafish Brain

A stereotaxic brain atlas (depicting brain sections in a micrometer scale), first had to be composed in order to do precise surgery on the adult zebrafish brain. This required defining a visible external landmark on the dorsal adult zebrafish skull that could be accepted as zero point (*origo or bregma)*, for further measurements.

Defining Bregma

The zebrafish skull exhibits similar structural characteristics as most vertebrate skulls. There are easily visible sutures between the cranial bones that can be used as a landmark. The zero point (bregma) for this study was selected at the crossing of sutures between the pre-parietal and parietal bones. At this point, the sagittal and transverse sutures meet perpendicularly giving a well-defined landmark to depict the brain beneath the skull. The skull of five adult zebrafish was photographed to document the best landmarks using a Nikon SMZ-U stereomicroscope and Moticam 5000 digital camera (Figure 4A). These structures are comparable to the published “roofing landmarks” of the *crossopterygian* fish (Kent 1992).

The Transposition of the Bregma over the Brain
and Scaling the Brain in Reference to the Bregma

To accurately transpose the location of the *bregma* to the underlying brain, first the animal was mounted on the stereotaxic holder and the electrode manipulator (a device that precisely measures distances in tenths of millimeters accuracy in all three dimensions of space) holding a 26G hypodermic needle, was positioned over the bregma and the x, y, z or anterior-posterior (AP), medial-lateral (ML) and dorsal-ventral (DV) coordinates were recorded. After removing the manipulator from over the head, while the fish was

held under deep anesthesia as previously described, the frontal, pre-parietal and parietal bones were removed with a 2.6mm Ziegler dissecting knife and #4 jewelry forceps exposing the brain. At this time, the manipulator was reinstated and the 3D coordinates at 36 selected points of the brain were measured and recorded (Figure 5).

In brief, the brain of each fish was divided into 5 mirrorly symmetrical (left and right) anatomical regions along the brain's long axis: olfactory bulbs, forebrain, optic tectum, cerebellum, and medulla. The AP and ML coordinates were recorded at each midpoint of each region and at their boundaries resulting in 9 points in total for a region (Table 3). The ventral coordinates however were not recorded until the brain was fixed and removed from the cranium. This procedure was repeated on ten different, similar size animals. The average for each point were calculated (Table 4) and those averages were used in scaling the brain for the stereotaxic atlas (Figures 4, 6, 7, 8).

Histotechniques

To create a stereotaxic atlas, the averaged coordinates were used to proportionate the brain sections to a millimeter scale in their photographs. Prior to this, serial sections of the adult zebrafish brain in all the three anatomical planes (horizontal, sagittal and cross-sectional) had to be prepared. For this reason, nine adult fish were killed and their brains were histotechnically processed for serial sectioning as follows.

To fix the brain, the frontal, preparietal and parietal bones of each adult zebrafish, were removed from the skull and the brain was exposed and immersed *in situ* into Karnovsky's fixative (4% paraformaldehyde, 2.5% glutaraldehyde, and 0.1 M phosphate buffer; PB) overnight. This allowed the otherwise extremely soft brain tissue to harden in its original position and maintain its intact shape. After the brain hardened, it was carefully removed from the skull, avoiding deformation, and post fixed in the same fixative for four days. The brain was then washed three times with 0.5 M PB (pH=7.2) prior to immersion into 1% osmium tetroxide solution for two hours followed by rinsing in PB again. This procedure accomplishes the fixation of both the proteins (paraformaldehyde and glutaraldehyde) and lipids (osmium tetroxide).

The fixed brains were then dehydrated through increasing concentrations of ethanol (50%, 70%, 96%, 100% and 100%) and propylene oxide, embedded into *Durcupan* (Fluka) and polymerized overnight in 60°C. Half a micrometer thick cross-sectional, sagittal, and horizontal serial sections of three brains for each plane were then cut on a Sorvall MT2-B ultramicrotome with freshly prepared glass knives. Sections were mounted on slides maintaining their order, stained with 1% tolludine blue containing 1% sodium tetraborate, and cover-slipped with DPX (BDH Laboratory

Supplies). Note: The serial sections were prepared by other students and generously provided for this study.

Microphotography

Selected sections were photographed on a BX40 Olympus light microscope equipped with a Sony Exwave analog camera connected to a PC with *Windows XP*. Photographs were captured with 10x objectives and 0.55x projective ocular and *Flashbus G32* (BiTMICRO) software. For each section about 25 individual frames were captured at this magnification. Individual photographs were sorted in *ThumbsPlus 3.0b-R* (Cerious Software, Inc.) program. Pictures for each section were then assembled into a complete, final montage using *Adobe Photoshop CS* (For *Windows XP*) and printed using Hewlett Packard DeskJet 970Cxi printer.

III. Results

One of the major results of this study was the successful design and fabrication of a special holding device for the small adult zebrafish that could fit into an available and expensive Kopf's rat stereotaxic apparatus. The created respiratory-irrigating system successfully maintains fish respiration and also serves as a head holding device. In short, a Plexiglas "holding plate" was designed with an attachable and adjustable needle delivering circulating water directly into the throat of the fish. The following describes the details of the stereotaxic device as well as the basic information pertaining to the stereotaxic brain atlas for the adult zebrafish.

The Holding Plate and Respiratory-Irrigating System of the Stereotaxic Apparatus

Figure 1 shows an overview of the modified Kopf's stereotaxic apparatus with mounted "holding plate" that was carefully created to hold an adult zebrafish. A holder for a stereomicroscope with lighting source as well as an independent adjustable light holder is also seen in this figure.

Figure 2 shows a close-up of the fish "holding plate" and how it is mounted on the rat "mouth holder" of the original Kopf's rat stereotaxic device. The plate itself is 11x11x2 cm plexiglass that is attached to the rat stereotaxic device by a "mounting screw". At the front of the plate is a small adjustable "mouth piece holder". The "mouth piece" itself is a large diameter (2-3 mm) syringe needle that is covered by a soft plastic tube to prevent injury to the mouth's mucus membrane. The mouthpiece also has a rubber "stopper" to prevent the needle to pass too deeply into the pharynx. A flexible tube then connects the mouth piece to a peristaltic pump which circulates tank water to the mouth of the fish. Consequently, the mouthpiece serves two functions: a continuous

water delivery and also firmly fixes the head of the fish as one of the three points, once the fish is secured from both sides by two adjustable arms (Figures 2 and 3). The restraining arms are lined with soft sponges to prevent dehydration and injury to the fish when restrained.

To mount the fish on the apparatus, the fish's mouth is first pulled onto the "mouth piece" to the stopper. The fish's body is then fixed into position by the two restraining "arms." This holding and restraining design is especially user-friendly---allowing even an inexperienced person to mount a fish in less than two minutes. After a fish is secured, the peristaltic pump supplies a continuous flow of tank water without restriction (i.e. "irrigating system") through the mouth, pharynx and gills. The water exiting the fish gills drops through two holes in the plexiglass holder into a "collecting basin" (positioned below the holding plate) and returns to the original peristaltic pump's reservoir. Thus, the irrigating water is continuously circulated. A fish, secured and maintained (irrigated) after a short anesthesia (short-term anesthesia) will remain motionless for up to one hour but will soon show withdrawal reflexes if exposed to a painful stimulus. However, if the irrigating water contains 1% Tricaine, the fish will remain sedated for the entire duration of surgical intervention.

Immobilization of Fish for Short-term

Table 1 shows the time needed to secure a fish on the device and the survival rate of animals kept on the holder for one hour using pure tank water for respiratory irrigation. It also shows the weight range and the survival of the fish 24h after manipulations. Animal weight ranged from 0.51g to 1.11g. Even an inexperienced experimenter needs only about 1.5 min to secure the animal, but this time frame gradually decreases with experience. Originally, only 70% of the animals tested survived on the device due to lack of experience. However, this percentage has increased to as high as a 95% survival rate with gained experience of the experimenter. Zebrafish who survived initially remained alive for at least 24h following restraint and their survival did not depend on their size.

Restraining Fish with Long-term, Deep Anesthesia

The optimal drug dosage for long-term, deep anesthesia was determined empirically to be 1% Tricaine solution. The designation of "optimal" was given to the Tricaine concentration that met the following two criteria: (1) the dilution had to be weak enough so as not to kill the fish over at least one hour exposure time; (2) the concentration had to be strong enough to keep the fish from exhibiting any escape reflexes when exposed to a painful (noxious) stimulus such as a transcutaneous needle

penetration rostral to the dorsal fin of the fish. It was found that 1% Tricaine solution could maintain the desired, prolonged, deep anesthesia of the fish allowing painless brain surgery.

Table 2 shows the time needed to secure a fish on the device and the survival rate of animals kept on the holder for one hour using 3%, 2% and 1% tricaine solutions for respiratory irrigation. It also shows the weight range and the survival of the fish 24 hours after manipulations.

Animal's weight ranged from 0.51g to 1.11g. With some practice, the experimenter needed only about 0.5 minutes to secure the animal into the apparatus. Apart from those four animals exposed to higher Tricaine concentrations (2%-3%), all animals survived on the device. Those who survived also remained alive at least for 24h following restraint. Survival did not depend on the size of the animal.

Defining the Bregma

To be able to create a stereotaxic brain atlas, the exact brain location had to be projected to a well definable, anatomical landmark, easily seen on the skull. This definable anatomical landmark is usually seen in mammals as an intersection of the coronal and sagittal sutures between the frontal and parietal bones, known as the *Bregma*,.

The dorsal portion of the adult zebrafish skull also has a well definable anatomical landmark between the two frontal and pre-parietal bones. This point was used in our work as the zero point of all measurements and for consistency was named *Bregma* as well. The *Bregma* of the adult zebrafish skull is shown in Figure 4A at the intersection of the longitudinal and horizontal zero lines. It appears at the apex (marked as a red dot in Figure 4A) of the V-shaped indention.

Figures 4B and 5 show the brain's dorsal surface after the removal of the frontal, pre-parietal and parietal bones. Clear boundaries can be seen between the exposed forebrain (Figure 4B-I), optic tectum (Figure 4B-II), and cerebellum (Figure 4B-III). These clear boundaries create a grid assisting in measurements of definable points of zebrafish brain (Figure 5). All measurements were made in reference to the 2c point of the grid and data averaged between 10 zebrafish (Figure 4B, Table 4).

The distance between 2a and 2e (the total visible length of the brain) averages 5mm; the width of the dorsal level of the optic tectum (Figure 4B; distance between 1 & 3) averages about 4mm; and the depth at the dorsal level of the bregma averages 3.5mm, respectively.

The Transposition of the Bregma over the Underlying Brain

The adult zebrafish brain cross-sectional (Figure 6), horizontal (Figure 7), and sagittal (Figure 8) sections are depicted in relation to the measured *Bregma*, respectively. The measures at the periphery of the pictures (same as on Figure 5) are expressed in millimeters (mm) with tenths of millimeters accuracy.

The optic tectum (a – Figures 6, 7, and 8) and the cerebellum (b – Figures 7 and 8) are the more complex, layered structures in the zebrafish brain. (Post fixation with osmium tetroxide labels the myelinated fibers black, which contrasts well with tolluidine blue allowing the ability to see both the cytoarchitectures of the brain as well as the fiber bundles. This combined staining allows for the observation of the major brain divisions, their organization into nuclei and lamiae as well as a description of the major tracts and commeasures.)

IV. Discussion

This study succeeded in creating a specific holding system for adult zebrafish that (1) can be easily attached to a Kopf's stereotaxic apparatus widely used for rodent brain surgery, (2) will keep the fish head firmly fixed with a three-point restraint system (one rostral and two lateral points) and (3) will allow irrigational respiration of the fish for as long as needed for a brain surgical intervention. The device was designed using information published by Aparecida (1998). This author developed a device to accommodate *Gymnotus carpo*, a significantly larger fish species. Aparecida also reported that the device could be used for stereotaxic recording and supplied some corresponding atlas figures as well. The novum in our device is twofold: (1) it is able to hold and respire a very small size fish and (2) can fit into an expensive stereotaxic device, an apparatus that most neuroscience laboratories are using for rodent brain surgeries.

The holding system allows even an inexperienced experimenter to mount a fully anesthetized fish in less than two minutes. The mounting begins by putting the animal onto a previously set (adjusted) mouth-piece (first restrain point). The body is then fixed along its two sides using the sponge paddles (second and third restrain points) in such a way that the longitudinal axis of the fish remains straight. At this time, the peristaltic pump, which is connected to a reservoir of water at one end and the mouth piece at other, is activated. With the help of the adjustable mouth-piece holder, the angle of the head is positioned dorso-ventrally until the fronto-parietal surface of the skull is horizontal. The mouth-pipe of the apparatus permits the water to enter the pharynx and pass across the lamellae of the gills. After which the water drops down into a lower

reservoir leaving the head dry for surgery. Meanwhile, the sponges of the lateral restraints collect some of the returning water and keep the fish's body hydrated.

Our experiment demonstrates that zebrafish can be maintained in this apparatus restrained painless with a continuous irrigation of 1% Tricaine for as long as one hour, much longer than brain lesion surgery needs. As an immediate use, the device will be used to prepare a complete adult zebrafish stereotaxic brain atlas. In addition to anatomical studies, the device can also be used in behavioral studies focusing, for example, on the visual ability of the fish with optic tectum lesion.

V. Acknowledgments

The authors thank the anonymous donors whose financial support made this research possible.

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Table 1: Survival of Adult Zebrafish Restrained on the “Holding and Restraining Plate” and “Respiratory Irrigation System,” for One Hour with Tank Water

Number	Weight (g)	Time to Fix (seconds)	Time of Restriction (hours)	Survival on Apparatus for 1h	Survival after 24h post trial
1	0.72	135	1	Y	Y
2	0.50	78	1	Y	Y
3	0.98	58	1	Y	Y
4	1.11	39	1	N	N
5	0.51	80	1	Y	Y
6	0.47	70	1	Y	Y
7	0.98	73	1	N	N
8	0.84	64	1	Y	Y
9	0.71	70	1	N	N
10	0.73	160	1	Y	Y
Mean	0.755	82.7	1	70%	70%

Table 2: Survival of Adult Zebrafish Maintained on the Respiratory Irrigator for One Hour with Tank Water Solutions of Different Tricaine Concentrations.

Number	Weight (g)	Time to Fix (seconds)	Dilution	Time of Restraint (hour)	Survival after 24h post trial
1	1.11	30	3%	1	N
2	0.53	32	3%	1	N
3	0.51	70	2%	1	N
4	0.83	80	2%	1	N
5	0.71	43	1%	1	Y
6	0.73	40	1%	1	Y
7	0.97	30	1%	1	Y
8	0.73	32	1%	1	Y
9	0.57	34	1%	1	Y
10	0.81	21	1%	1	Y
11	0.60	24	1%	1	Y
12	0.64	29	1%	1	Y
13	0.91	36	1%	1	Y
14	0.79	31	1%	1	Y
Mean	0.75	38	1.43%	1	71%

Table 3: Adult Zebrafish Brain Stereotaxic Legend

1	M	Medulla	
2	CB / M	Cerebellum	Medulla
3	CB 1	Cerebellum Midpoint	
4	CB / OT	Cerebellum	Optic Tectum
5	OT 1	Optic Tectum	
6	OT / FB	Optic Tectum	Forebrain
7	FB 1	Forebrain Midpoint	
8	FB / OB	Forebrain	Olfactory Bulbs
9	OB	Olfactory Bulbs	

Table 4: Average measurements taken from ten zebrafish.

Stereotaxic Parameters of the Adult Zebrafish Brain

	Bregma
AP	29.9 mm
ML	11.2 mm
DV	30.9 mm

	Average
length	38.6 mm
volume	59.7 □L
mass	0.746 g

	mm AP		mm L(left)	mm M	mm R(right)
1	-2.1		+0.5	11.0	-0.5
2	-1.2		+0.6	11.1	-0.6
3	-0.4		+0.7	11.1	-0.7
4	+0.5		+1.2	11.2	-1.2
5	+1.1		+1.9	11.2	-1.9
6	+2.0		+1.4	11.3	-1.4
7	+2.4		+0.8	11.3	-0.8
8	+2.5		+0.5	11.2	-0.5
9	+2.7		+0.3	11.2	-0.3

DORSAL

	AP		L(left)	M	R(right)
1	-3.7		-3.7	-3.7	-3.7
2	-3.0		-3.0	-3.0	-3.0
3	-2.9		-2.9	-2.9	-2.9
4	-1.9		-1.9	-1.9	-1.9
5	-2.2		-2.2	-2.2	-2.2
6	-2.3		-2.3	-2.3	-2.3
7	-3.3		-3.3	-3.3	-3.3
8	-3.4		-3.4	-3.4	-3.4
9	-3.5		-3.5	-3.5	-3.5

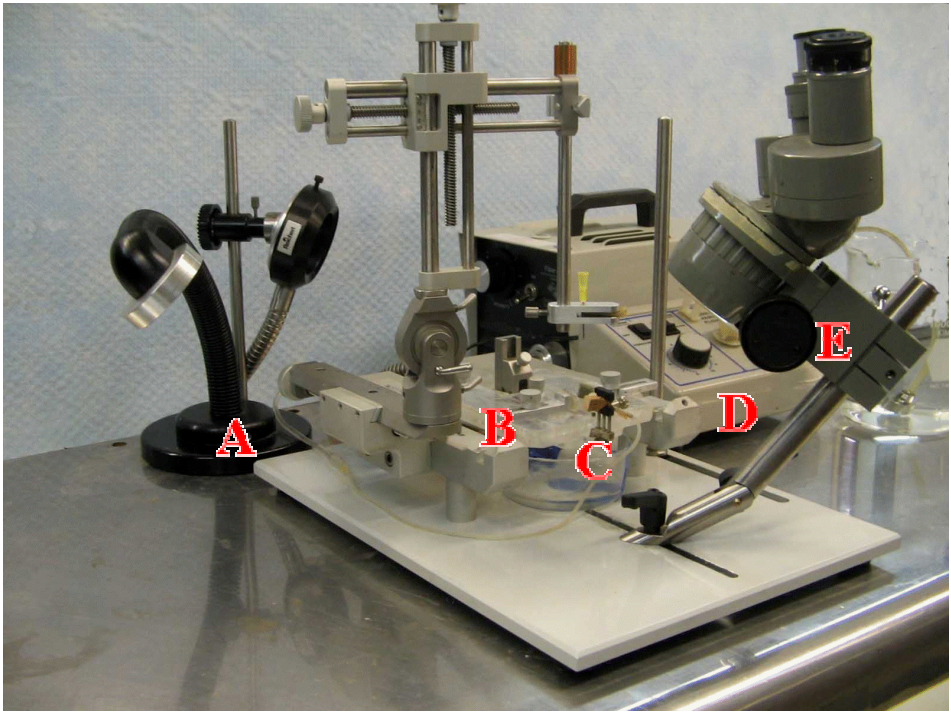

Figure 1: Overview of modified Kopf's rat stereotaxic apparatus

A – Independent Adjustable Light Source
B – Holding Plate
C – Collecting Basin
D – Peristaltic Pump
E – Stereomicroscope and Holder

The figure above shows all of the components of the developed stereotaxic apparatus. A description of all these components can be found under "The Holding Plate and Respiratory-Irrigating System" of the Results section.

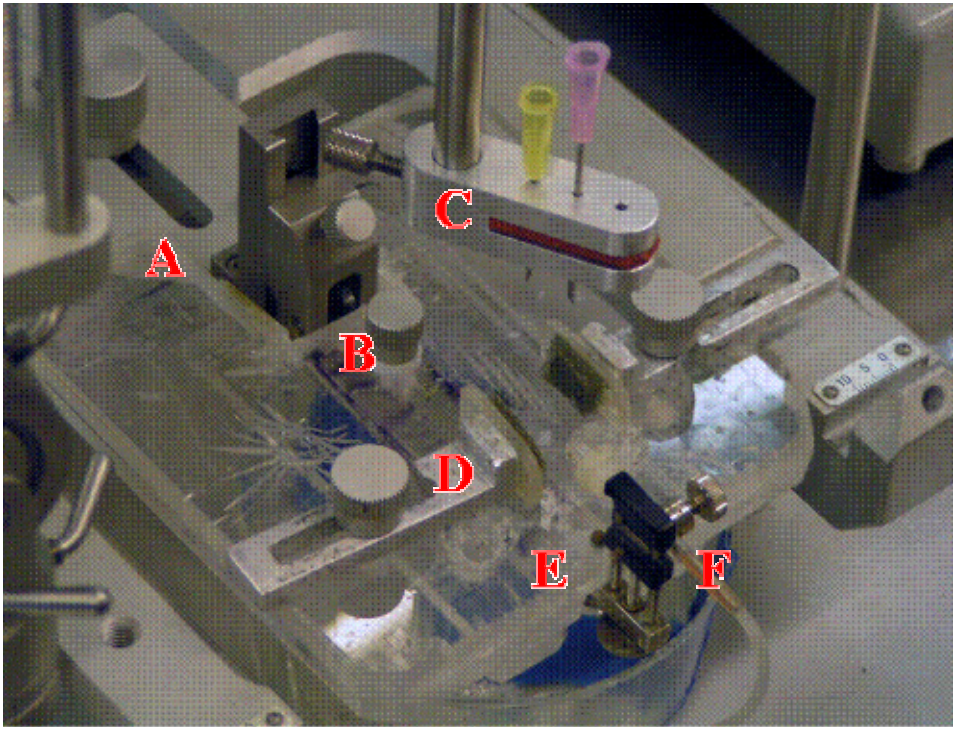

Figure 2: Close up of "holding plate"

A – Rat Mouth Holding Device (where holding plate was mounted)
B – Mounting Screw
C – Hypodermic Needles and Holder
D – One of the Two Restraining Arms with Soft Sponge Lined Paddles
E – Drain Hole
F – Adjustable Mouth Piece Holder

The "holding plate" was mounted to the original Kopf's stereotaxic apparatus to the "rat mouth holding device" (A). The "holding plate" is secured to the apparatus by a "mounting screw" (B). The hypodermic needles are held by a constructed holder (C) and are used to pinpoint specific regions of the brain for measurement (Figure 5, red dots). The adjustable "restraining arms" (D) as their name implies, are used to restrain the fish's body (at both sides of the fish) to the apparatus. These "restraining arms" are also lined with soft, spongy foam paddles which keep the fish gently fixed as well as moist to avoid dehydration of the fish skin while in the device. Water irrigated to the fish to maintain its

respiration, is upheld by the small “adjustable mouth piece holder” (F). The water exits through the fish gills drops down two “drain holes” (E) into a “collecting basin” below the “holding plate.” A better view of the “collecting basin” can be seen in Figure 1, A.

Figure 3: Close-up view of zebrafish mounted on stereotaxic apparatus.

Each zebrafish was secured at three points (once at the mouth and twice along their sides) in their natural position, resting on their abdomen (see figure above). The mouth of the fish was opened and pulled on a plastic tube connected by the “mouth piece holder.” The diameter of the tube tightly fits the diameter of the mouth of the zebrafish; therefore, the zebrafish head is fixed onto the apparatus not only by the paddles located at each of their sides but also by the “mouth piece” itself. The “mouth piece” is further connected to a peristaltic pump (Figure 1, D) which irrigates water to the mounted zebrafish. The two “holding arms,” positioned to secure the sides of the zebrafish, allow room for the gills to open and close during irrigation.

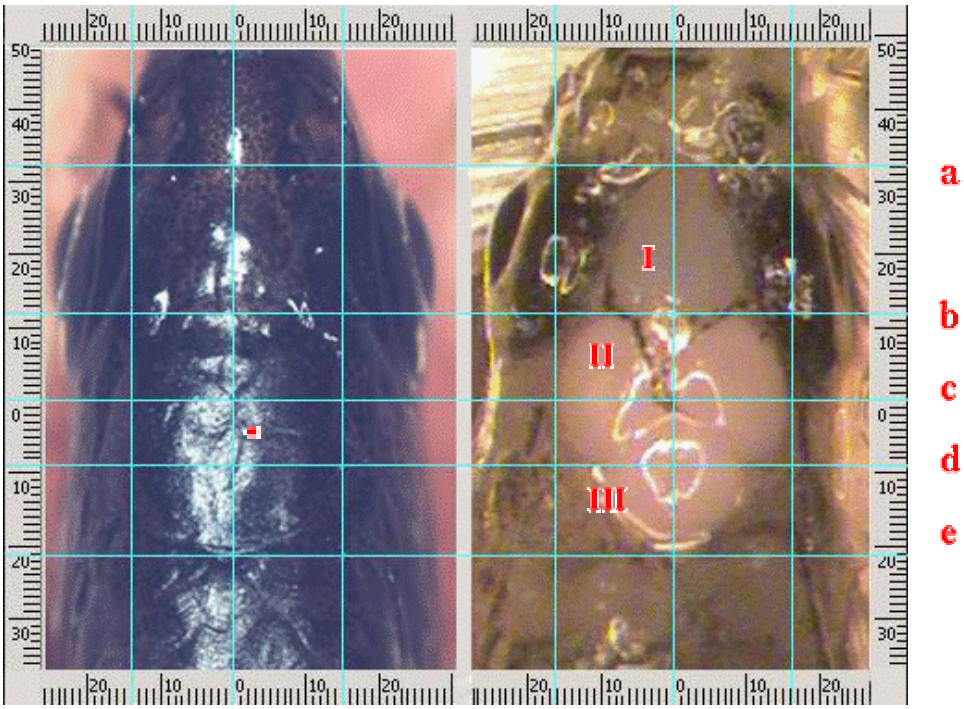

Figure 4: Transposition of *bregma* in relation to unexposed and exposed zebrafish brain.

I – Forebrain II – Optic Tectum III – Cerebellum

Figure 4: (A) depicts the *bregma* (i.e. zero point) location. The *bregma* is located at the cross points of the longitudinal and transverse zero line (red dot). At the red dot, note the V-shape, pointing caudally; (B) depicts the three divisions of the adult zebrafish brain compared to the location of the *bregma* (Figure 4, A) as well as the rest of the exterior portion of the skull including the cranial sutures. All measurements were made in reference to the 2c point: the distance between 2a and 2e (the total visible length of the brain) is about 5mm; the average width at the top portion of the optic tectum (distance between 1 and 3) is about 4mm; the average depth at the level of the *bregma* is about 3.5mm.

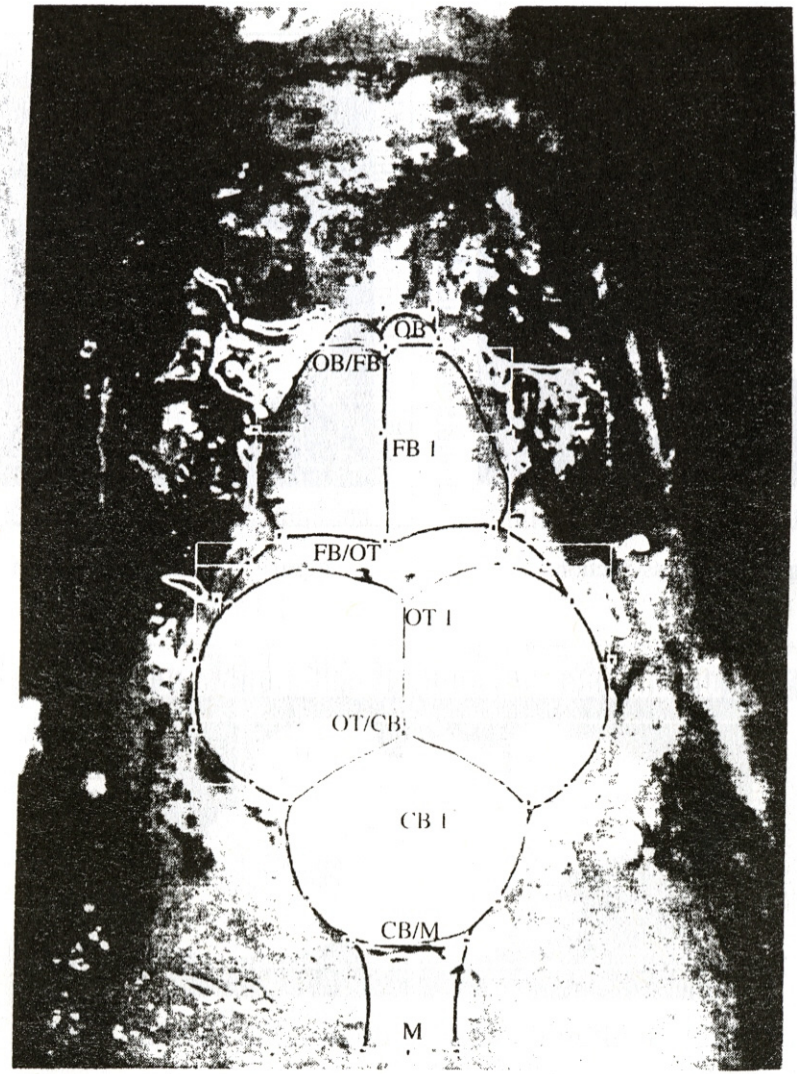

Figure 5 – Parameters of the zebrafish brain in cranium

This figure depicts the 36 points (red dots) of the adult zebrafish brain that are measured using the stereotaxic apparatus after the *bregma* (i.e. zero point) location is recorded from the skull. At each red dot, three planes of measurements (i.e. anterior-posterior, medial-lateral, dorsal ventral) can be measured to the tenth of a millimeter precision from the distance of the recorded *bregma* (see Figure 4 for *bregma* location; refer to Table 3 for abbreviation explanation).

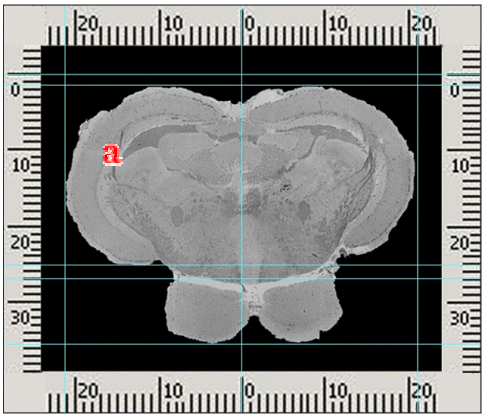

Figure 6 – Cross-Section

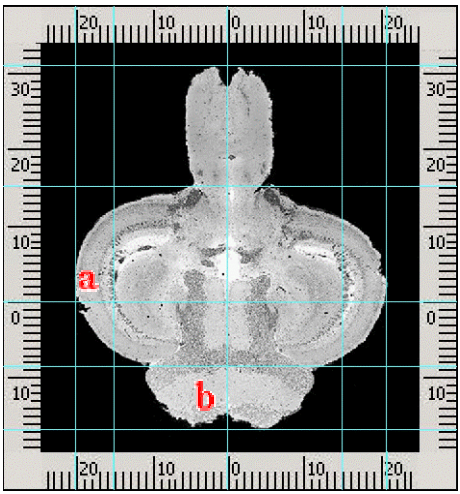

Figure 7 – Horizontal Section

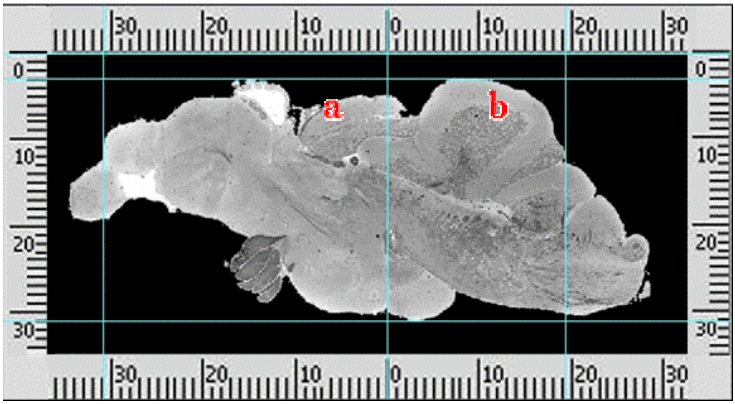

Figure 8: Sagittal Section

a – Optic Tectum b – Cerebellum

Figures 6, 7 and 8 above illustrate the transposition of the brains location in relation to the *bregma*. The measurements depicted in the images above represent the average distances recorded using the stereotaxic apparatus (see Table 4). Note the differences in complexity between the layers of the optic tectum (a) and the cerebellum (b). This is due to the light microscopy preparation technique. Post fixation with osmium tetroxide labels black the myelinated fibers which contrast very well with the tolluidine blue allowing not only the ability to see cytoarchitecture of the brain, but also the fiber bundles as well.

Section III:
The Social Sciences

Crossing the Burning Sands: A Social Psychological Investigation of Hazing

Christianna Gozzi (Psychology)[1]

Hazing, the initiation rituals of many national Greek social organizations, has resulted in extreme harm, including hundreds of deaths, in its longstanding tradition. Researchers have found that the severity of initiation, cognitive dissonance, dependence theory and social affiliation theory may explain this complex psychological phenomenon. The current study predicted that participants who believe that they have been specially chosen to participate in a research study and who partake in a bonding activity will report more liking for a group than those participants who were neither specially selected nor bonded to their peers. A pilot study was conducted. All the participants perceived that their performance in two initiation tasks was contingent upon admission into an attractive group. Possible alternatives to hazing and theoretical explanations of hazing are explored.

I. Introduction

As individuals cycle through the ceremonies of life, they tunnel through a series of decorative initiation rituals specific to each culture. Life is, therefore, a chain of initiations. According to anthropologist Victor Turner (1987), initiation rites signify changes in states of beings. Bearing in mind that initiation rites are commonplace in life, they vary in intensity according to the group. For example, the traditional Mexican quinceañera, is an exciting and innocuous festival that initiates young girls into womanhood (Vida, 1999). There are, however, unnecessarily violent initiations that are inexplicably desired and expected by individuals and society at large. For instance, female genital mutilation is traditional in some cultures, undergone by 100 to 140 million girls, of either cutting or removing the clitoris and in some cases, stitching the hymen closed. In societies that support this act, which is banned by the World Health Organization, it is considered to be a religious requirement that ensures chastity, cleanliness, and marriage, while preventing promiscuity and excessive clitoral growth (Skaine, 2005). While female genital mutilation is considered to be inhumane and

[1] Research performed under the direction of Dr. Amy Eshleman (Psychology) leading to the completion of an Honors thesis and a presentation at the 61st Eastern Colleges Science Conference.

oppressive by human rights groups, many Africans, including women, support the practice and consider it to be a necessary female rite of passage.

Harmful and severe initiations, much like female genital mutilation, are not removed from the Western world. Hazing in American Greek organizations provides an accessible means for studying severe initiation rituals specific to American culture. Hazing is defined by the Fraternity Executive Association as: "any action taken or situation created intentionally, to produce mental or physical discomfort, embarrassment, harassment or ridicule… " (Nuwer, 1990). Greek rituals almost always involve hazing despite the threat of disciplinary action.

The term hazing was originally used to refer to British sailors who had successfully passed the equator. The practice is now illegal in all but seven states, but has existed in university settings since the twelfth century and in militias and armies since ancient times. Martin Luther, the founder of Lutheranism, is claimed to have hazed Wittenberg seminary neophytes by forcing them to wear yellow horns and soaking them in vats of red wine as a means of symbolically purifying them for induction (Nuwer, 1990, 1999).

The notions of fraternal organizations arrived in the United States in 1776 in the form of Phi Beta Kappa; a literary society which initially offered men outlets to discuss the current break from the British Parliament. In a similar literary tradition, the first sorority was established in 1851 (Robbins, 2004). Fraternity hazing was popularized in the United States in the 1880s when Zeta Chi members began convincing pledges to stick their tongues out to be branded. Since the first recorded hazing death in 1838, hundreds of deaths and injuries have been reported mainly by members of fraternities. Neophytes have been killed by plummeting to their own death, hit by cars and trains after being dropped off in the woods blindfolded, shot by an outraged member, asphyxiated after being buried in a sand grave, drowned in a swimming ritual, overdosed on alcohol, and frozen to death after being dropped outside on a winter night (Nuwer, 1990, 1999).

The victims of hazing fatalities are sometimes blamed for their involvement in the rituals. Hazing deaths may be explained by several theories. Ritual may arouse human's innate tendency toward violence, enabling members to act according to the moral standards of the Greek organization and stray from the morays of society as a whole (Nuwer, 1999). This may be the result of a phenomenon known as groupthink in which group decisions may become fallible because of mindless conformity, lack of vigilance, excessive risk taking and severe misjudgments (Nuwer, 2004). Accordingly, members who act especially violently may be venting their own internal frustrations on

the neophyte, or the pledging process may bring out extreme violence in members who are undiagnosed as mentally ill (Nuwer, 1999).

Binge drinking may also influence hazing injury by increasing a propensity toward violence (Nuwer, 1990). In fact, 70% of fraternity members report drinking at least thirteen alcoholic beverages in a row; while 35% of sorority members claim to drink between seven and twelve drinks in succession at least three times per week. (Harrington, Brigham & Clayton,1997)

Aside from the debate concerning the violence of hazing, fraternities have also been criticized for being racist, classist and sexist. Therefore, the first African American fraternity was established in 1903 with the intent to vocalize racial solidarity. African American fraternities are typically reputed to mirror ancient Egyptian secret societies and emulate traditionally African initiation practices (Brown, Parks & Phillips, 2005).

The hazing epidemic is entrenched in the politics of gender, and as fraternities and sororities are naturally divided along gender lines, they wittingly and unwittingly thrust gender issues into the spotlight. For instance, sorority members are expected to starve and purge themselves into an unrealistic two-dimensional waif standard of beauty (Robbins, 2004). Some sororities extend bids based on the aesthetics and household income of the prospective member to ensure the homogeneity of their group (Robbins, 2004; Atlas & Morier, 1994).

Accordingly, fraternity brothers are imparted with a hyperbolic notion of chiseled hegemonic masculinity that reflects the violence, misogyny, and homophobia that is endemic to some fraternal hazing (Nuwer, 2004). Violence is indisputably related to hazing as neophytes are subjected to paddling and forced calisthenics. As overt aggression and hegemonic masculinity are linked in American culture, the violent nature of the system tends to be unique to fraternities and is relatively rare in sororities, which use psychological humiliation as a means for hazing (Wright, 1996).

Furthermore, both male and female members of Greek organizations tend to adhere to more traditional norms of male dominance and female submissiveness (Kalof & Cargill, 1991). Misogyny bleeds through the fraternal system as a mechanism to enhance male superiority (Jones, 2004). Many, while certainly not all, fraternities have been accused of incredulous acts of gang rape in which women have been raped by up to eleven fraternity brothers in one evening (Sanday, 1990; Robbins, 2004). Gang rape reinforces the objectification of women along with diminishing the value of femininity in American culture. Furthermore, gang rape can be perceived as a homoerotic experience in which males have sex with each other through the disposable feminine body (Kimmel, 2004).

With such an emphasis put upon female conquest, openly homosexual men have largely failed to find their way in fraternities. While many openly homosexual fraternity brothers have found solace in the acceptance of their peers, many closeted fraternity brothers have found it impossible to reveal their sexuality. Openly homosexual fraternity brothers have also reported a higher level of abuse and denigration than heterosexual brothers because of the intense emphasis on masculinity (Windmeyer & Freeman, 1998). Ironically, there have been cases in which men have reported abusive homosexual acts in the pledging process. These men have been raped while in bondage and been forced to give each other oral sex and manual stimulation while reciting the fraternal oath (Wingate, 1994).

Within most Greek organizations, hazing occurs during what is known as the pledging process, or a full semester in which the neophyte learns about the organization and bonds with the members in order to be inducted into the group. The five major components of Greek rituals are character, scholarship, service, fellowship and religion (Jones, 2000). The pledging process forcibly disconnects the pledges from their former social lives and is marked by an emphasized interaction with the Greek organization (Nuwer, 2004).

Current members test the adaptability and bond of the pledges by physically and psychologically diminishing their integrity. Some examples of hazing activities include paddling, calisthenics, whipping, confinement in a small space, branding, required unflattering uniforms, degrading nicknames, consumption of disgusting food combinations, excessive drinking, sexual assault and psychological abuse (Nuwer, 2004). Furthermore, pledges may be prohibited from showering, shaving, brushing one's teeth, speaking to outsiders and sleeping no more than the absolute minimum (Wright, 1996). During the pledging process, hazing reinforces the limbo-like stage in which pledges can no longer identify with their previous lives but are not yet allowed to identify with the organization (Leemon, 1972; Turner, 1987).

The last and most strenuous week of the pledging process, known as Hell Week, marks the culmination of all the hard work and hazing abuse that the pledges have endured in the previous months. During the final night of Hell Week, many organizations conduct a ritual in which the pledges are buried or symbolically killed. In sum, the pledges are physically and psychologically deconstructed, their old identities are symbolically squelched and they are reborn in the image of their letters (Wright, 1996). Once the initiation is completed, there is a ceremony called "crossover night" in which the pledge is inducted and vows to adhere to the conditions of the organization (van Gennep, 1960).

The Greek organization represents a parental authority that the new member submissively learns from and serves (Nuwer, 2004). The pledging process is a way of leaving a legacy without passing on one's genes; in fact, many organizations assign "big brothers and sisters" to new members as a way to ease them into learning the behaviors that will enable them to emulate the social reputation and goals of the organization. Hazing reinforces the social hierarchy of the organization represented by the superior current members and the lowly neophytes who bond through their status (Turner, 1987; Nuwer 1999; Keating et al., 2005).

Despite the encircling controversy over deaths and inhumanity related to Greek organizations, most Greek members support hazing for several reasons: "You don't question it, because the thought never comes to your mind. This is what they always did, and this is what we do, and they all got through it" (Nuwer, 1990). They may view hazing as an exciting adrenaline heightening game or a testament to their human will and strength that links them to a lineage of successful brothers and sisters. Actually, 77% of fraternity members and 63% of fraternity alumni claim that hazing serves a valuable purpose and the most common reason given for the purpose of hazing is the construction of pledge class unity (Baier & Williams, 1983). Accordingly, 65% of fraternity members do not think that individuals should be allowed into a Greek organization if they do not want to be hazed (Cokley & Wright, 1995).

Those that haze new members view the process as carrying on a valuable tradition which aides the group in weeding out undesirable and weak individuals. Moreover, many Greek organizations stress the secrecy of the process and refuse to discuss their rituals with any outsiders. The completion of hazing rituals may elicit feelings of invincibility in the members and create a formidable bond between the individual and the organization (Jones, 2000).

Pledges, on the other hand, may feel intensely pressured to conform by their friends and family because they desire friendship and the availability of a large and well-equipped social network. Consequently, enduring the unpleasantness of hazing may outweigh the possibility of being alone during their college years. In fact, senior Greek members report increased self awareness, self-acceptance and aspirations than senior non-Greeks (Hountras & Pederson, 1970).

Considering the violence and secrecy that is symptomatic of hazing, the pledging process mystifies outsiders. If pledges define the process as real and inescapable, they will fulfill their roles as servile and easily manipulated followers (Sweet, 1999). Jones (2000) argues that one cannot simply dismiss the violence of hazing as inhumane and inexcusable, but understand its social and historical context. Moreover,

once these elements are understood, researchers can begin searching for ways to ameliorate the injury and loss of life that occasionally occurs during hazing. Furthermore, the psychological underpinning of hazing may be explained by a combination of psychological phenomena.

While there is some variation, the majority of psychological literature demonstrates that the more severe the initiation, the greater the liking for the group (Feldman, 1977). The seminal study in the psychological research on the severity of initiation rituals is Aronson and Mills' (1959) research on the effects of severity of initiation on liking for a group. The female participants were led to believe that their admission into a group that was intended to be boring (unknown to the participant) was contingent upon their performance in a severe initiation or a mild initiation. In the severe group, participants were required to read an embarrassing and sexually explicit passage, while participants in the mild condition were asked to read sexually innocent material. Aronson and Mills determined through the post experiment self-reports that individuals are more likely to report liking for an unattractive group after enduring a severe initiation. An experiment by Gerard and Mathewson (1966) supported Aronson and Mills' (1959) conclusion that suffering leads to liking through replication, but supplemented the sexually explicit material with electrical shocks to safeguard against the possibility that sexually explicit material could arouse the participants and thus create an increase in liking. Furthermore, they asserted that liking resulted from an inconsistency in the individuals' behavior which resulted in cognitive dissonance.

Cognitive dissonance refers to the cognitive inconsistency which results from undergoing an unpleasant experience (Festinger, 1957). It follows: "I degraded myself to join a group, therefore this group must be extremely worthwhile." Cognitive dissonance frequently occurs outside of conscious awareness, and while it may explain hazing, individuals seek to avoid the uncomfortable feeling of dissonance through justifying their behavior by emphasizing the fun and challenging aspects of the process (Festinger, 1957; Brehm, 1960). While the experimental study of cognitive dissonance has been criticized for being so intricate that the variables are ultimately confounded, it is also pertinent because individuals will seek to alter their perception of an aversive and irreparable event such as hazing (Cooper & Fazio, 1984; Chapanis & Chapanis, 1964).

Schopler and Bateson (1962) demonstrated that severity of initiation increases liking but disagreed with Aronson and Mills' (1959) theory that cognitive dissonance was at the root of this social phenomenon; instead, they posited dependence theory as responsible for the increase in liking after a severe initiation. Dependence theory states that individuals will act out the set of behaviors that they have learned to be desirable

when interacting with individuals they are dependent on in order to achieve a desirable outcome. In other words, pledges are dependent upon current members in order to be inducted into the organization so they consequently act in a manner that they know will appease and comply with the member's wishes (Thibault & Kelley, 1959). Many pledges and current Greek members support hazing and describe it as a fun and challenging mind game (Nuwer, 1999). Therefore, in order for pledges to report liking for the Greek organization, they must perceive the group to be attractive and at least somewhat meaningful (Hautaluoma, Enge, Mitchell, & Rittwager, 1991).

In addition, individuals who are in degrading situations, much like the pledging process, or situations in which they perceive that they will fail tend to seek out social affiliation. Keating, Pomerantz, Pommer, Ritt, Miller and McCormick (2005) found that individuals who were in discomforting initiation procedures reported higher levels of social dependency and a more negative mood when left alone than did individuals who endured a mild initiation. Van Duüren and Di Giacomo (1997) demonstrated that social support is an essential component of affiliation during debasing experiences which offers some explanation for the bonding of pledges during hazing rituals.

There has been a significant body of research conducted mimicking hazing within Greek organizations. Keating et. al (2005) attempted to simulate the Greek organization selection process and initiation objectives by convincing participants that they would be performing a series of initiation tasks for upperclassmen researchers and could be selected to evaluate the performance of other students. Each participant was brought to the observation room to meet two confederates who acted in a friendly, outgoing manner. The observation room was made to look like their hang-out place with comfortable furniture and warm lighting and participants were shown how the upperclassmen researchers would be able to observe and judge their behavior—which created a feeling of status, affiliation and privilege. As part of an initiation task, the participants were asked to explore several items using only their sense of touch and smell and describe them as creatively as possible. Hautaluoma et. al (1991) created a similar experiment in which they attempted to create a meaningful group of upperclassmen researchers and convinced participants that their performance on initiation tasks was contingent upon acceptance into this group.

The current research takes an innovative approach to hazing while incorporating established research. It is suggested that participants who have been told by the researcher that they have been specially chosen to participate in the study in which they will be eligible to join a desirable group, will report a higher level of liking for the group than participants who sign themselves up for the study (Hypothesis 1). This element

simulated the selection process of Greek organizations and the elite allure of Greek organizations and the potential influence that this has on pledges.

Furthermore, considering the research of Van Duüren and Di Giacomo (1997), participants endured two initiation proceedings 1) a scavenger hunt 2) and creatively describing unusual combinations of common household items while blindfolded, either working as a group or individually. Therefore, it was suggested that participants who completed the initiation proceedings in a group would report higher liking for the group than those participants who completed the tasks individually (Hypothesis 2).

Finally, it was predicted that participants who were not only specially chosen but also completed the "initiation rituals" together, would report the highest overall level of liking as compared with other groups (Hypothesis 3). In order to fully understand the impacts of hazing rituals, the researcher integrated the methodology of Keating et al. (2005), Aronson & Mills (1959), Schopler & Bateson (1962), and Hautaluoma et al. (1991) and added original components to test new hypotheses.

The purpose of the present project was a pilot test to explore the feasibility of conducting in-depth, deceptive research with confederates in order to capture these phenomena in a laboratory at a small liberal arts college.

II. Method

Participants

The participants were 14 undergraduates (6 men, 8 women) at Wagner College, a small Northeastern liberal arts college, who were students in *Introduction to Psychology* classes. All participants received research credit for the course. The age of the participants ranged from 18-22 and they were predominantly of Caucasian ethnicity. The study was approved by the *Wagner College Human Experimentation Review Board* and informed consent was obtained for each participant prior to the experiment.

III. Procedure

The researcher created a 2 x 2 design which comprised four groups that were labeled as 1) chosen-bonding, 2) chosen-no bonding, 3) not chosen-bonding, 4) and not chosen-no bonding.

Chosen-Bonding Group

Participants in the chosen-bonding group received an email detailing that they had been specially selected to participate in a secretive study (see Appendix A). This served to replicate the rush process and the allure of a secret society that exists in many

Greek social organizations. They were asked to all wear a black shirt to the study (to create visual conformity). They were each given a nametag with a nickname made of colored paper (names of cities—to simulate the nicknames that Greek organization members choose for pledges as a way to reform their identity).

The participants arrived at the laboratory and were greeted warmly by 3-4 confederates posing as upperclassmen research assistants. The laboratory was made to look like a fun and privileged place to hang out by putting blankets and pillows around the room and turning on music. Participants were told that their performance would be monitored by the group and if they performed well during the study, they might be chosen to assist the research students in future analyses. They were then asked to complete a demographic questionnaire (see Appendix B).

The first task of the participant group was a scavenger hunt that is not only a bonding experience, but also an innocuous and fun initiation rite that occurs in many Greek organizations and is integral to the pledging process. The participants were told that they must work to find the reward in 40 minutes in order to be accepted into the group of confederates posing as upperclassmen researchers. The researcher gave the group of participants an initial clue leading to various clues enclosed in manila envelopes located around campus which led them to a prize of candy (Appendix C). The total time to complete the hunt was recorded.

Once the participants returned with the scavenger items, the researcher gave the participants their candy reward and congratulated them on their job and told them that since they had done such a good job, the entire group would be chosen contingent on the next task ("Wow, you guys did such a good job. You were the quickest out of all the groups before you. We are thinking of taking all you guys if you do really well on the next task").

The participants were then asked to sit around the table in the center of the lab. The goal was to work together as a group and describe the unidentified objects as creatively as they possibly could by using only their senses of touch and smell. They were told that the upperclassmen researchers would be observing their responses and rating them against other groups. They were given 15 minutes to complete the task. This process represented a more severe initiation process because the participants were asked to touch unpleasant objects without knowing what they were and felt pressured to perform well because their performance would be rated by "upperclassmen researchers."

Once the participants were seated and understood the rules of the task, the researcher asked them to tie on their own blindfolds (pieces of fabric) and make sure that they could not see through it. The researcher placed an object in the center of the table

and a rag next to each person's side (so that each person could wipe his/her hands). The researcher remained in the room while the participants underwent the initiation process in order to create a sense of authority that is present in Greek initiation processes. Each member of the group was asked to touch, smell and describe (1) wet tea bags, (2) oatmeal with cotton balls, and (3) Jell-O with potato chip pieces. After the descriptions, the participants were told that they may remove their blindfolds and were given paper towels to clean their hands if they desired.

Participants then completed a survey detailing their liking for the group (see Appendix D). The survey used a Likert scale rating system ranging from Strongly Agree to Strongly Disagree. The researcher thanked the participants for their participation and discussed any questions or concerns that the participants might have had. They were told that they would receive an e-mail detailing the results of the study that actually debriefed them of the true intents of the study. The message was sent after all the data were collected and participants were invited to contact the researcher to discuss the study.

Chosen-No Bonding Group

Participants underwent the same selection process as the first group. The only differences were that the participants did not receive nametags, were not asked to wear black, and endured the initiations individually. Each participant worked alone on one clue during the scavenger hunt task (they were only given 20 minutes to retrieve the clue items). After the scavenger hunt, each participant was individually led into a small room adjacent to the lab in which he/she sat face to face with the experimenter while blindfolded and used his/her sense of touch and smell to describe the unidentified objects as creatively as possible. The remaining participants waited in the lab while each participant underwent initiation procedure individually.

Not Chosen Groups

The third and fourth groups endured the identical procedure as the first and second groups, respectively, except that they did not receive a special invitation to participate and signed up for the experiment on their own.

IV. Results

The sample size was too small to accurately test the hypotheses for the pilot test. The surveys were coded on a 5-1 scale (5 = Strongly Agree and 1= Strongly Disagree, and 5 = Very Pleasant and 1 = Very Unpleasant). They were scored by calculating four scores that were labeled as 1) liking, 2) meaningfulness, 3) performance, and 4) pleasantness. The liking score determined the participants' liking for the group of

upperclassmen researchers and their desire to be a member of the group. The meaningfulness score determined how important the group of upperclassmen researchers was to the participants and whether or not the group meant something to them. The performance score ascertained how hard the participants worked on the tasks and whether or not they felt that completing the tasks improved their chances of being accepted into the group. And finally, the pleasantness score evaluated how pleasurable the participants perceived the initiation tasks to be. A score was calculated for each participant and averaged to determine a respective score for each group. The not chosen-no bonding group liked the group of upperclassmen researchers the most. The bonding-chosen group finished the scavenger hunt the quickest. The bonding-chosen group also reported the greatest pleasure in completing the initiation tasks. Finally, the bonding-chosen group completed the scavenger hunt the quickest out of the bonding groups; while the no bonding-not chosen group completed the scavenger the quickest out of the not chosen groups. The means and standard deviations for all groups are depicted in Table 1.

V. Discussion

Due to time constraints and limited resources, it was only possible to conduct a pilot run of this study. It is not yet possible to perform statistical analyses that would be meaningful to the hypotheses; therefore, none of the predictions were supported. Surprisingly, participants who signed themselves up for the study and endured the initiation tasks individually claimed to like the group of upperclassmen researchers the most. However, this group was extremely small (N = 2) and the participants happened to be acquainted with the confederates and may have genuinely liked the confederates, or felt pressured to report that they did. The pilot study revealed that it might be necessary for the participants to get to know the group of upperclassmen researchers a little more before they will report liking for the group.

Participants who were specially chosen and completed the initiation tasks as a group; finished the scavenger hunt the quickest and took the greatest pleasure in completing these tasks out of the other groups. These participants may have felt privileged to have been asked to participate in the study and therefore worked the hardest on both tasks. These results may also be evidence of dependence theory in that participants are working hard in order to yield the best possible outcome—or admission into the group of upperclassmen researchers. Furthermore, the participants in this group seemed to get along really well with each other and appeared to be enjoying themselves throughout both initiation tasks. Considering these findings, it was somewhat unexpected that this group did not all strongly agree to liking the upperclassmen researchers or find

the group extremely meaningful. In fact, they appeared to like each other more than the group of upperclassmen researchers and may have been just getting through the initiation tasks in order to receive the research credit.

The pilot test may have uncovered that in order for participants to report liking for the group of upperclassmen researchers, they must feel more acquainted with the group. Furthermore, by feeling acquainted with the group of upperclassmen researchers, they may feel more comfortable reporting that the group meant something to them. It is hard to expect a participant to report that a group of strangers means something to them, even if they went through an initiation. Furthermore, the test also may have uncovered that it is important for the participants to feel bonded to each other in order to perform their best on initiation tasks.

The pilot test also revealed that participants did not find the smell and touch activity especially challenging or disgusting, which was the hope of the researcher. While many participants verbalized their disgust during the task, most reported that they enjoyed it. Perhaps the chosen-bonding group would have reported liking for the group if they had reported less pleasantness for the initiation task. Considering these implications, the pilot test was only capable of capturing initiation tasks that were perceived as fun and innocuous. However, it is possible that cognitive dissonance may play a role in this. If the participants were really disgusted by the second initiation task and ashamed of their involvement, they might report an inflated sense of pleasantness.

The results of the pilot test may expose that it is necessary for pledges to get acquainted with the Greek organization members and get a sense of the group before they can really determine whether or not the group will be useful to them. This may explain the elaborate meet and greet social functions during the rushes of many Greek organizations. It seems that the selection process gives pledges incentive to do their best during Greek rituals. Furthermore, it is important in most cases that they will bond with each other in order to maximize their performance during hazing rituals. And finally, perhaps hazing does not have to be debasing or disgusting in order for pledges to get something out of the initiations and bond with their peers.

This pilot study could be greatly improved upon with the simple addition of time expansion and more participants. Participants would have more time to get to know the group of upperclassmen researchers. They could come to the lab three or four times and chat with the researchers individually and build a relationship. In order for the study to be more psychologically realistic, the laboratory should look more like a dorm room than a lab, which could be solved by conducting the experiment in a dorm room or coffeehouse. Participants could meet confederates at their apartments for the experiment. Time

expansion would also allow for longer and more in-depth initiation tasks. Larger participant groups would allow for the replication of larger pledge classes in order to understand if the size of the pledge class has any effect on liking.

Furthermore, the confederates should act in a friendly manner when meeting the participants but in a cool manner when administering the initiation tasks as a way to simulate hazing. The participants of the current study did not seem to understand the significance of wearing the same color—this might work best if the experimenter gave the participants a pledge shirt. Also, giving the participant more incentive to want to join the group would be helpful such as more research credit and invitations to elite parties hosted by the group of upperclassmen researchers.

While 47% of fraternity members agree that hazing is a problem on their campus, it is extremely difficult to eradicate. As examined in the introduction of the current study, most Greek organization members believe that hazing exists for reasons that are steeped in years of unquestionable tradition. They also believe that hazing strengthens new members and testifies to overcoming the challenge of the human condition. The secretive and sacred nature of ritual has discouraged victims of hazing to speak up against their organization that may be protected by universities that wish to avoid controversy (Nuwer, 1999).

Many hazing violators are not prosecuted or are exonerated from the criminal charges surrounding hazing deaths (Nuwer, 1999). In order to reduce hazing injury, colleges and universities should adhere to a zero-tolerance hazing policy. Educational institutions should also consider appointing a specific faculty or staff member to document hazing complaints, evaluate Greeks and non-Greeks on hazing behavior, protect those Greek organizations that do not haze, postpone or eliminate rush and bolster anti-hazing activism from students, staff and faculty (Nuwer, 1990, 1999; Bryan, 1987).

Moreover, Greek organizations should work hard to stamp out violent hazing and drop archaic principles of racism, misogyny and homophobia. Those members who are involved in hazing deaths should be held criminally responsible. The PanHellenic Society oversees the actions of national Greek organizations, and has been fairly outspoken against hazing, although few Greek organizations actually adhere to anti-hazing regulations (Robbins, 2004; Nuwer, 1990, 1999).

In many cases, colleges and universities deny the existence of hazing and will do everything in their power to conceal its existence in order to deflect legal action. However, many colleges and universities have also attempted to abolish hazing (Nuwer, 1990, 1999). Abolishing the deeply embedded Greek organization that is unique to

American university culture may force hazing underground and make it even harder to regulate.

In conclusion, increased communication between administration and Greek organizations would be the optimal plan to eradicate violent hazing. Hazing is an extremely complicated psychological phenomenon. It is, therefore, hard to achieve psychological realism within a laboratory setting. The current study sought to eliminate as many confounding variables as possible, and proved to be an interesting way to study hazing.

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Appendix A: Email Message to Members of Chosen Groups

March 27, 2007

Hello,

Special opportunity! You are one of very few individuals who have been specially chosen to participate in my research.

My name is Christy Gozzi and I am senior psychology major. I am conducting a study on creativity through independent and group tasks and I would like to inform you that you have been specially selected to participate in this study! Your participation will fulfill the necessary research credit to successfully complete Psychology 101. Participating in this study would not only be an extremely educational and fun experience for you but also a way to get ALL your research credits done at ONE time.

I urge you to participate in this study which will take less than 80 minutes of your time. Also, if you do decide to participate please remember that you have been specially chosen and to not share your involvement with anyone. Please let me know if you are available to participate by TUESDAY, APRIL 3. The study will be conducted on Thursday, April 12. Please let me know which time slot of 4:15 pm-5:30 pm or 5:45 pm - 7:00 pm works best for you. You can contact me at cgozzi@wagner.edu or (203) ***-****. There are a limited number of slots, so please sign up quickly! You will NOT need to sign up through Experimentrak. Thank you for your consideration and I look forward to hearing from you.

Christy Gozzi

Appendix B: Personal Information Sheet

NICKNAME:

AGE:

SEX:

ETHNICITY:

CLASS:

CLUBS/ORGANIZATIONS YOU ARE INVOLVED IN:

Appendix C: Scavenger Hunt Clues

OBJECTIVE: As a team, you must work together to find clues that will direct you to your reward. You will be timed and have 30 minutes to complete the task. Please bring all the clues and mentioned items that you collect along your journey back to the researcher. HAVE FUN!

CLUE #1: Use your head! Find your first clue upstairs in the XX section in the Smartest place on campus. Write down the names of the two books that the clue was placed between so I know that you have been here. Proceed to the next spot…

CLUE #2: You are performing well: let this next clue entertain you. Write down the names of two people starring in the next Wagner College Production (check out the black & white photos) so I know that you have been here. Proceed to the next spot…

CLUE # 3: Way too many stairs: take an elevator ride all the way up to the best View on campus for your next clue. Grab a take out menu on your way out, so I know that you have been here. Proceed to your final clue…

CLUE # 4: Run around: collect your next item where, on a warm day, you may get hit in the head with a Frisbee or a hackie sack. Bring me back a handful of something green so I know that you have been here. Please return to the psychology lab to collect your prize!!

Appendix D: Questionnaire

Bonding Condition

1. I like the group of upperclassmen researchers.

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. I would like to be a member of this group.

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. I am important to the group.

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. The group meant something to me.

Strongly Agree Agree Neutral Disagree Strongly Disagree

5. Performing my best improved my chances of being accepted into the group.

Strongly Agree Agree Neutral Disagree Strongly Disagree

6. I performed as well as I could.

Strongly Agree Agree Neutral Disagree Strongly Disagree

7. Please rate the pleasantness of the scavenger hunt.

Very Pleasant Pleasant Neutral Unpleasant Extremely Unpleasant

8. Please rate the pleasantness of the creativity exercise.

Very Pleasant Pleasant Neutral Unpleasant Extremely Unpleasant

9. All the tasks that I completed were worth it.

Strongly Agree Agree Neutral Disagree Strongly Disagree

10. The tasks bonded me to the other participants.

Strongly Agree Agree Neutral Disagree Strongly Disagree

No Bonding Condition

1. I like the group of upperclassmen researchers.

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. I would like to be a member of this group.

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. I am important to the group.

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. The group meant something to me.

Strongly Agree Agree Neutral Disagree Strongly Disagree

5. Performing my best improved my chances of being accepted into the group.

Strongly Agree Agree Neutral Disagree Strongly Disagree

6. I performed as well as I could.

Strongly Agree Agree Neutral Disagree Strongly Disagree

7. Please rate the pleasantness of the scavenger hunt.

Very Pleasant Pleasant Neutral Unpleasant Extremely Unpleasant

8. Please rate the pleasantness of the creativity exercise.

Very Pleasant Pleasant Neutral Unpleasant Extremely Unpleasant

9. All the tasks that I completed were worth it.

Strongly Agree Agree Neutral Disagree Strongly Disagree

10. The tasks bonded me to the other participants.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Author Note

My interest in hazing began when I was a freshman at Wagner College and I witnessed several of my friends pledge Greek organizations. The psychological components of hazing have fascinated me for the past four years, and I am grateful for the opportunity to act upon my academic and social curiosities. I would like to thank the psychology department at Wagner College for excellent resources and guidance, especially Dr. Amy Eshleman for being a supportive and diligent coach and Dr. Laurence Nolan for four years of comic relief and consistent guidance. I would also like to thank Bess Goden and Ana Culver for their abundant support and compassion, and Phillip Marotta for a shared love of research, knowledge, and life.

Personal Communication Styles in Organizations

Joseph Pantone (Psychology)[1]

Communication is an essential component of organizational behavior. Communication in organizations is interpersonal, involves transmitting messages among employees or groups of employees. There can be either personal communication or object communication, the latter being a more dehumanizing form of communication. There are three major kinds of personal communication styles, Noble, Socratic, and Reflective. In the present study, employees' personal communication styles were measured. It was hypothesized that employees at Beacon of Hope House would have similar scores for all three communication styles, which indicates that these employees are unaware of their personal communication styles, which leads to ineffective communication. Results showed that all employees who participated in the study were classified as having a Reflective communication style.

I. Introduction

One of the essential features of a successful organization is communication among employees and groups of employees. Communication can be thought of as the process by which a person, group, or organization (the sender) transmits some type of information (the message) to another person, group or organization (the receiver), (Greenberg, 2003). The communication process can be thought of as a feedback system. The sender encodes a message and transmits the message through a communication channel, such as e-mail or memo. The message is decoded by the receiver, who then provides the sender with feedback. This feedback allows the sender of the message to determine if their message had been understood properly (Greenberg, 2003).

Schneider et al. (1975) states that all organizations have what is called interpersonal communication. This type of communication is generally conducted between peer groups, but it can exist between higher levels of authority and subordinate levels. Interpersonal communication usually involves work processes, questions, or training interpretation (Schneider et al.,1975) . Schneider argues that one of the major problems that occurs in communicating information is distortion, or blocking. Employees may tend to hear what they want to hear, and this leads to distortion in our ability to

[1] Research performed under the direction of Dr. Richard Brower (Psychology).

understand, comprehend, relate, communicate, visualize, and interpret the message (Schneider et al., 1975). The loss of meaning from one employee to another is known as entropy. This idea holds that distortion occurs not only in the sender, but in the receiver as well.

Related to the idea of interpersonal communication is how we treat others when we are communicating. Kreps (1986) states that there are two types of communication, personal and object communication. He argues that object communication is insensitive and demonstrates a lack of respect for another person. This type of communication treats the receiver as an object, and therefore has a dehumanizing component to it. Personal communication shows respect for the other person, and treats the receiver as an equal. This type of communication promotes communicating in an honest and trustworthy manner (Kreps, 1986).

All of these aspects of communication can be applied to many different agencies, ranging from financial corporations to social service agencies. Upon observing communication among employees at Beacon of Hope House, a social service agency which promotes independent living skills to psychiatric patients, it was noticed that there was a lack of communication among employees concerning many topics, such as food preparation and medicine changes for clients. This led to hostility and a lack of cohesiveness among employees, which created a poor working environment. McCallister (1994) suggests that there are six personal communication styles, and that employees with similar communication styles will communicate better than those whose styles are different. The three main styles are Noble, Socratic, and Reflective. Noble communication style refers to someone who says what is on their mind without any reservation. Socratic communication styles refers to someone who likes to argue his or her point fully. Reflective communication style refers to someone who would rather say nothing than to hurt someone else's feelings. The proposed hypothesis states that employees at Beacon of Hope House will have similar measures of these three styles, which would indicate that they are unaware of their own communication styles, which is an essential component of effective communication (Greenberg, 2003).

II. Method

Participants

Seven employees from Beacon of Hope House were selected to complete a personal communication survey. All seven employees were female, and they ranged in age from 32 to 57.

Materials

An 18-item questionairre, adapted from McCallister (1994), was given to each employee. The first six items measured an employee's degree of Noble communication. The second six items measured an employee's degree of Socratic communication. The final six items measured an employee's degree of Reflective communication. Each of the three groups of items were scored independently of each other. For example, if an employee's Noble score was higher than the other two, they would have a Noble communication style. Each item was answered by participants with either a “yes” or “no” response.

III. Procedure

Each of the seven employees were asked to complete the 18-item questionnaire to assess their personal communication styles. For each item, participants were asked to think of how they *actually* communicate, rather than what they think they should do. Participants were given as much time as necessary to accurately assess how they communicate. Participants were debriefed and informed about what the questionairre was designed to measure.

IV. Results

Results showed there was a dominant communication style among employees at Beacon of Hope House, Reflective communication style. The mean score of the Noble scale was $\bar{x}=2$. The mean score of the Socratic scale was $\bar{x}=2.8$. The mean score of the Reflective scale was $\bar{x}=4.28$ (see Figure 1). The percentage of "yes" responses for the Noble scale was 33 percent. The percentage of "yes" responses for the Socratic scale was 47 percent. The percentage of "yes" responses for the Reflective scale was 71 percent.

V. Discussion

The purpose of this study was to determine employees’ personal communication styles. It was hypothesized that employees at Beacon of Hope House would have similar scores on the three scales, indicating that the employees are unaware of their own communication style, which would lead to ineffective communication. The results of this study contradicted the proposed hypothesis. Employees at Beacon of Hope House tend to have a Reflective communication style. Those who have a Reflective communication style are concerned with the interpersonal aspects of communication. They do not wish to offend others, and they tend to be great listeners.

McCallister (1994) states that those with similar communication styles tend to communicate better than those with different communicating styles. This was not the case in the present study. This is significant because there must be another factor that could account for the ineffective communication. One possibility could be within each employee's communication style. Each employee was classified as having a Reflective communication style. As such, employees may be overemphasizing the feelings and emotions of others as to not offend them in any way. They may be withholding information from others, or not interpreting information properly as intended by the sender because of the fear of causing conflict on the job.

McCallister (1994) points out that it is important to remember that employees have the potential to use any of the three styles of communication. Relying on one style all of the time may be counterproductive. Employees may not be getting the proper information to perform their job properly. In this case perhaps someone with a Noble communication style would be needed, as they would not have the tendency to filter what they are thinking and come out and be direct. A possible solution for ineffective communication would be for employees to synthesize the three styles of communication. This is a more inclusive way of communicating, and would allow employees to communicate better with each other, no matter what communication style they may have.

VI. Future Work

One way to improve future studies of personal communication styles would be to have a larger experimental population. The present study focused on only seven employees. Another way to improve further research into communication styles would be to include men in the sample. A sample that includes men would be more representative than just using women alone. Further research that includes both men and women would help demonstrate if men would also be classified as Reflective communicators. If men are shown not to be Reflective communicators, this may give some evidence that Reflective communicators are generally women.

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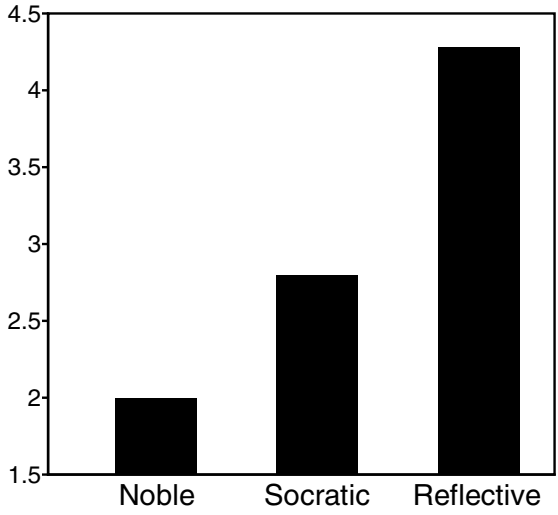

Figure 1: Mean personal communication style scores for Noble, Socratic and Reflective measures

The Relationship between Stereotype Threat and Performance on a Standardized Test: Why Minority Students Do Not Perform As Well As Caucasian Students

Kim Costa (Psychology)[1]

Although standardized tests are created by professionals who try to ensure that everyone has an equal opportunity to excel, African Americans still fall behind their White peers' scores. Stereotype threat affects a student's performance on a standardized test by increased anxiety, measured by their blood pressure. As part of a independent t-test, 52 undergraduate college students (27 women, 15 men) were assigned to one of two groups, where a stereotype threat or no threat stereotype was implemented into the classroom. The participants were instructed to take a "fake" standardized test, and when completed their blood pressure was taken. Interestingly, the group with the stereotype threat implemented had higher blood pressure values than the group without stereotype threat.

I. Introduction

Standardized tests have been used for many years to assess a student's mastery of skills in a variety of subjects. These tests are created by professionals, who try to ensure that the tests are non-bias and that everyone has an equal opportunity to excel. However, research has convincingly demonstrated that minority students, particularly African- Americans, receive much lower scores than their fellow Caucasian classmates. A possible explanation of this gap is caused by stereotype threat. Schmader & Johns (2003) define stereotype threat as, "a phenomenon whereby individuals perform more poorly on a task where a relevant stereotype or stigmatized social identity is made salient in the performance situation" (p. 2).

Although all students experience anxiety in school situations, research shows that students of minority groups suffer from additional anxiety. This increased anxiety can lead to students devaluing or reducing their identification with academics (Osborne, 1999). Stereotype threat undermines academic performance in two ways. First, it can interfere with performance by increased anxiety. "In many of the studies, levels of anxiety (measured by blood pressure), were significantly higher under conditions of stereotype threat" (Aronson, Fried & Good, 2001). Secondly, stereotype can affect

[1] Research performed under the direction of Dr. Richard Brower (Psychology).

performance by disidentification. Aronson et al. (2001) define disidentification as, "the psychological disengagement from achievement hypothesized to help students cope with stereotype threat and underperformance in a given domain" (p. 114). College admissions base their acceptance decisions heavily on the performance of a standardized test, such as the SAT. Since a gap exists between the performance of Caucasian and African American students, it is not surprising that less than 10% of African Americans attend a four year collage. (Good, Aronson & Inzlicht, 2003, p. 646).

Schmader and Johns (2003) found research done in support of the stereotype threat theory shows that performance differences can be eliminated if the same test is administered in a stereotype-free environment. Steele and Aronson (1995) found that African Americans performed worse than their White peers when the task they were performing was described as a measurement of intellectual ability. On the other hand when the same task was described as unrelated to intellectual ability, African American students performed equally to White students. These findings suggest that negative stereotypes about certain ethnicities can create an extra burden, which can interfere with the student's performance on a task (Schmader & Johns, 2003).

In many previous studies, researchers have conducted experiments to find solutions to eliminate the gap in test scores. Good et al. (2003) examined whether implementing an intervention that addressed possible explanations for academic difficulty, and beliefs about stereotypes, could reduce the effects of stereotype threat and thus raise performance. College mentors conveyed messages to seventh-graders which believed would help alleviate stereotype threats. The college mentors discussed various issues, which included, adjusting to a new school environment, the expandable nature of intelligence, and the dangers of drug use. The study was conducted in a rural, low-income, school district in Texas. One hundred and thirty-eight seventh-graders were participants, both male and female (Good et al., 2003). The seventh-grade students underwent the informative program starting in mid-October to the end of the school year when they took the statewide standardized test, TAAS, in reading and math. Good et al. (2003) found that by implementing an intervention program, minority students' test performance increased, comparable to their White peers. These finding were consistent with their hypotheses. By implementing an intervention program, the performance differences among White and African American students were eliminated. If the belief of expandable intelligence, the idea that future and more in-depth learning is possible, is valued in school systems, standardized testing may be more equitable for students carrying the burden of stereotype threat.

Schmader and John (2003) found evidence to suggest that stereotype threat reduces working memory capacity. Schmader and Johns (2003), stated, how their goal was to examine the disruption of performance by confirming a negative stereotype about a certain group. Schmader & Johns (2003), define working memory capacity as, "The type of memory used to retain and manipulate information for immediate or near-immediate use" (p. 3). The researchers created a stereotype threat based on the implication that Latinos are less intelligent than Caucasians. The participants were told that the task was a measurement of general intelligence, and were asked to indicate their ethnicity on the test. However in the stereotype condition, the researcher informed the participants that their performance is "highly predictive of performance on intelligence tests and their performance on the test would be used to establish norms for different groups" (Schmader & Johns, 2003, p. 10). The results of the study provided evidence for the hypothesis that stereotype threats reduce memory capacity. When the test was described as a measure of general intelligence, Latinos recalled fewer words than Caucasians. However, there were no significant differences in self-reported ethnicity and test description. Both Latinos and Caucasians felt that the researcher would not score their test based on ethnicity. When the test was described as a measure of general intelligence, Latinos reported higher anxiety levels than Caucasians.

The purpose of the present investigation was to see if in fact a relationship existed between stereotype threat and performance on a standardized test. I wanted to see if by implementing a threat the student would not perform to their ability because of increased anxiety measured by their blood pressure. To explore if these two issues were related a "fake" standardized test was created and issued to two groups of African American students. One group was given the test, asked to write their ethnicity on the test to see if it increased anxiety, and told that the test was a non-evaluative problem-solving task. The other group was given the test, asked to write their ethnicity on the test as well, and was told that the test was a measurement of general intellectual ability. When the students completed the task, their blood pressure was measured by a blood pressure monitor.

I predicted that the group with the stereotype threat in effect would not perform as well as the participants who were completing the non-evaluative task, because of increased anxiety measured by their blood pressure.

II. Method

Participants

The participants were 52 African Americans college students (27 girls, 25 boys) at a liberal art college in Staten Island, N.Y. The participants' ages *(*M = 20.46, S.D=1.20) ranged from 19-24. One participant dropped out of the study because of a medical illness. The participants were recruited primarily from psychology and statistic classes and were given extra credit in their courses for completing the study.

Design and Materials

A "fake" standardized test measuring math and reading skills was issued to the participants. A "fake" test was created, since I was interested in increased anxiety rather than the correct responses on the test. The test consisted of 300 questions, 150 in math, and 150 in reading. The students were provided with a math formula sheet which contained formulas that would be used in the test. Some examples include the formula for area of a triangle and the Pythagorean Theorem. The students were also issued an answer sheet, scrap paper, a pencil, and a calculator. The students had 3 hours to complete the test. A blood pressure monitor was also used to take the students' blood pressure upon completing the task.

III. Procedure

The 52 African American participants were randomly assigned into one of two groups of 26. Group stereotype was informed that the test was a measurement of general intellectual ability; where group no stereotype was told that the test was a non-evaluative performance task. Both groups were assigned to different classrooms and were told that they were able to leave when they completed the test. Both groups completed the test at the same time. The groups were assigned to different classrooms, since the stereotype would be announced verbally. The participants were seated in rows. The researcher distributed a test booklet, answer sheet, formula sheet, pencil, and calculator to each participant. The rules of the test included staying in the seat assigned until finished, no talking, having nothing on the desk except the materials given, and not being able to leave the classroom until completing the test. The participants were given a time limit of 3 hours to complete the test. The participants were instructed to indicate their ethnicity on the test in both groups to see if it did increase anxiety. Upon completion of the test, the researcher collected the materials from each participant; and then took and recorded the participant's blood pressure. The participants were then thanked and dismissed.

IV. Results

To test the hypothesis that stereotype threat affects a student's performance by increased anxiety measured by their blood pressure, I conducted a two-tailed independent group t-test predicting that increased anxiety measured by blood pressure values would be significantly related to stereotype threat. High blood pressure values were significantly related to stereotype threat, $t(49) = -3.71$, $p < .01$. As depicted in Figure 1, the participants without stereotype threat blood pressures values *(*M = 115.73, SD = 22.01) were significantly lower than those participants with stereotype threat *(*M = 139.76, SD = 24.25). As depicted in Figure 1, there is a significant relationship between participants with stereotype threat and increased anxiety measured by blood pressure values.

V. Discussion

The results of the present study confirm that stereotype threat affects student's performance by increased anxiety, measured by their blood pressure. There was a significant relationship between stereotype threat and increased anxiety resulting in higher blood pressure values.

This evidence links to Aronson and Fried and Good's hypothesis on increased anxiety. They also found that by inducing a stereotype threat, emphasizing intelligence as a measure of intellectual ability, or having test takers indicate their ethnicity, significantly undermined the performance of African Americans. In their study, levels of anxiety measured by self-report inventories and direct measures of blood pressures were significantly higher under conditions of stereotype threat.

Although there was a significant relationship between stereotype threat and increased anxiety, I did not take into account possible medical conditions. If medical conditions, such as high blood pressure, or if a student was on medication existed this could have affected the data. Another possible weakness of this study is that since the participants were college students there was no control of activities that the participants engaged immediately before their participation. For example, if the participants come right from the gym an increase in blood pressure would be expected.

If a future study was to be done on a stereotype threat and increased anxiety, the researcher should make sure that participants do not have any ailments that would affect the data in any way. Also, the researcher should ask the participants to arrive at the study earlier so that one can be sure that their blood pressure is at a normal level and is not increased from any type of exercise or stress.

In the meantime, the present study provides an empirical perspective on stereotype threat and underperformance caused by anxiety. Although this may be an

ongoing problem, studies have shown that it can be eliminated by administering the test in a stereotype free environment and establishing the notion that all students have the potential to succeed.

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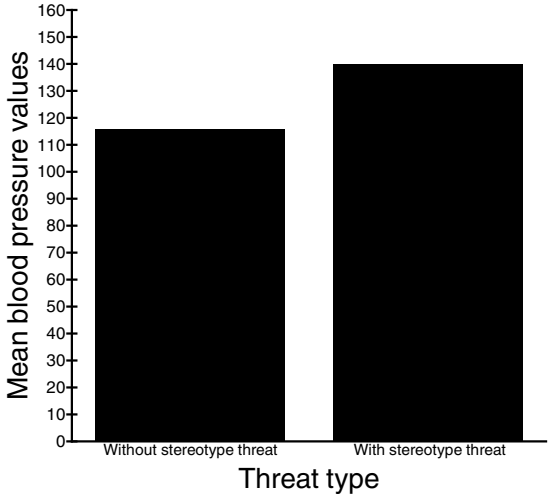

Figure 1: The mean blood pressure values depending on whether a stereotype threat was implemented in the classroom.

Section IV: Critical Essays

Language and Paralanguage: Music and Art as Communication in the *Law of Love*

Valerie O'Donnell (Spanish)[1]

While languages may differ among nations and peoples, the fact is that we as human beings are capable of formulating and making abundant use of language to communicate many things: our needs, our emotions, our darkest fears and deepest desires. This quality is found across races and nationalities and sets us, as humans, aside from other members of the animal kingdom. Animals communicate, yes—but as far as we know, they do not possess a true language, a "formalized code used…to communicate with one another" (Heward 302). People, on the other hand, have not one language, but many. The majority of these languages are spoken, and even unspoken linguistic systems—for example, American Sign Language—contain elements that could be considered 'words'. As a result, it is generally accepted that words (spoken, written or otherwise communicated) are the means by which people express themselves. To carry this theory one step further, in literature, words are supposedly the only means by which the author can convey setting, plot, dialogue and character psychology to the readers. Laura Esquivel disproves this theory in her novel, The Law of Love. Through her use of music and art in conjunction with written language, Esquivel shows that media other than written language must be used in order to adequately convey the deep emotional revelations and psychological responses of her characters.

The Law of Love is known as a "multimedia novel," packaged with a music CD. In the novel, characters experience frequent flashbacks to previous lives, "which for the reader involves examining color illustrations while listening to the CD, then reading the account" (Martínez 892). This is an interesting decision on the part of the author, considering that while many books contain illustrations, few have their own soundtracks. This feature of the novel indicates that it is characteristic of Esquivel's work to push the boundaries of literature and the idea of what should be considered a 'book'—notably in Like Water for Chocolate and The Law of Love. And yet, while reviews for Like Water for Chocolate appear overwhelmingly positive, it seems that many critics read The Law of Love's risk-taking format as a publicity stunt, or even an annoyance. One such critic,

[1] Written under the direction of Dr. Marilyn Kiss (Languages) and associated with the course SP213/EN213 *Hispanic Literature in English Translation*.

Evelyn Leeper, says in her review, "Ultimately, I found this book had too much science fiction to work as a fantasy, too much fantasy to be good science fiction, and too many gimmicks to work as a novel" ("The Law of Love"). However, it would be a mistake to assume, as does Barbara Mujica, that "Laura Esquivel is a master of gimmickry…In La ley del amor the gimmick is music" (Mujica 61), because the use of music to accompany art and writing in the novel serves a grander purpose than simply pandering to the public with attention grabbing stunts. The music is in fact part of the novel's unique construction, as "complementing this intermingling of media is a blurring of boundaries between literary genres as the book moves from science fiction to romance and New Age philosophy" (Taylor 2). Furthermore, without the addition of music and art in The Law of Love, the story of the characters' past lives would not come through as clearly. The artistic and musical components of this multimedia novel are indeed important means of communication to the reader—so much so, that perhaps they could even be considered "languages" themselves.

Before one even thinks about the role of art and music in The Law of Love and Esquivel's motivation for including them at all, it might be helpful to step down a bit and look at each genre of music that was included. Consequently, by seeing the ways the music can be linked to the text, the reader may come to a closer understanding of the author's reasons for making the novel into a multimedia experience. When considering why Esquivel chose to include the particular music found on the CD, one may first consider the danzones, which are used to set the stage for the chapters they precede. The words are closely aligned with the story's action: a chapter about the villainous Isabel is anticipated by a song called "Mala;" "San Miguel Arcángel" leads into a chapter narrated by Anacreonte, the protagonist Azucena's griping Guardian Angel—in short, the song lyrics correspond directly to what's going on in the novel. The one exception to this rule would be "A Su Merced," which does not precede a chapter but is rather sung by Cuquita to aid in performing a regression on the 'spoon' that registered Citlali raping Rodrigo in 1890. The song itself is about fruit, but the subtext of the song reflects envy, pride—many emotions found in the story. And the title, translated as "At Your Mercy," may signify that Azucena and her companions are at the mercy of Isabel and her minions' refusal to play by the rules. The operatic interludes from the works of Puccini, on the other hand, are intended to accompany the characters' flashbacks, and their significance is twofold. Firstly, in many cases the arias themselves relate to the flashbacks similar to the danzones and their chapters. The use of "O Mio Babbino Caro" (literally, "Oh My Dear Daddy") starkly juxtaposes scenes of a heartless Isabel bludgeoning her infant granddaughter Azucena to death, yet also seems oddly appropriate in the context of the

novel—the song is a daughter's plea to be allowed to marry her sweetheart, while Isabel's daughter leaves home to run away with her lover (and stepfather) Rodrigo. "Nessun Dorma" ("No One Sleeps;" a love aria) is the ironic companion to a 19th century rape scene. Conversely, the elation of the final scenes where the Law of Love is finally reinstated is heightened by the jubilant "Diecimila anni al nostro Imperatore!" ("Ten thousand years to our Emperor!"—perhaps a reference to the return of the dominion of the Law of Love and Divine Will). In different ways, all of the musical selections that are included with the book complement the plot, which proves that the author put thought into her selections, rather than just throwing in random songs haphazardly for the sake of including music.

On another level, the use of classical music can be traced to Azucena's work as an astroanalyst (futuristic psychoanalyst) and the traditional role of instrumental music in the retrieval of repressed memories and deep-seated emotions in psychotherapy: "The interplay of pulse and the 'rhythm of the soul' together with its realization foster trans-processes and lead to a hypnotic state which forms the basis for further interventions or self-regulation" (Mastnak 81). Psychologists recognize the transformative and reflective power of music, and as a result music often has a prominent place in different forms of counseling and therapy. Even in less specialized fields, music can be found being used to influence people's states of mind (think of the soothing music played at nail salons and yoga studios, where patrons go to clear their minds and relax). Defending her use of music with her novel in a 1996 interview with Joan Smith, Esquivel claimed that "because the music causes altered states of consciousness in the characters, I wanted the readers to share the experiences of the characters as much as possible" ("Love and Other Illegal Acts"). The central role of music in The Law of Love is notably revealed when Azucena first realizes that she regressed to a life where she saw Rodrigo, in an altered state of consciousness induced via a duet from Madama Butterfly: "It had been known for some time that musical sounds have a powerful influence on the human organism and can alter psychological states…recently, however, it had been discovered that a single melody had the power to activate our memory of past lives" (Esquivel 53). This discovery was an epiphany for Azucena, and it initiated major developments in the plot.

Similarly, the presence of visual art representing the character's flashbacks is essential in that it gives concrete images to changes in space, time and reality that could otherwise confuse the reader. It is rather impressionistic in its style, vividly capturing individual moments like snapshots and offering a quick glimpse into the moment. By viewing the pictures, readers are allowed to formulate their own perceptions about the scene taking place, which in turn creates a feeling of oneness with the work. The reader is

transported to another world as an invisible spectator, a character in the background—a phenomenon much like the one experienced while reading high-quality prose.

Since the role of music and art in The Law of Love has been established as an important companion to the written text, it follows to discuss their roles as paralanguages. A paralanguage could be considered something other than conventional language, written or spoken, that accomplishes all of the purposes that language addresses—conveying emotions, relaying information, demonstrating opinions, etc. Artistic media are especially good at conveying emotions, as can be seen in The Law of Love. Conveying emotion is one of the most commonly evoked and important roles of language, but some emotions are too strong, too raw to really come out in words. There simply aren't words powerful enough to express, for example, the hatred the female Rodrigo feels for his rapist/brother-in-law Pedro/Citlali, and so the memory of this past life can only be accessed when the Rodrigo of the present is exposed to classical music. Azucena is familiar with this idea, due to her background in astroanalysis—as she tells the bureaucrat at COPE, "Oh, it's not that I'm interested personally. But in my work as an astroanalyst it's very useful to be familiar with music that can induce altered states of consciousness" (Esquivel 51). She is the one who first realizes the connection between opera and regression to past lives and thus travels to the black market to buy an illegal CD: "Studies in experimental psychology…show empirically not only that listeners associate images, feelings and impressions with music, but also that…there is a convergence of opinion regarding the experience evoked" (Nattiez 243). The use of music is also at times even more useful for evoking a story than literary narrative, for "literary narrative is invention, lying. Music does not lie" (Nattiez 244). The feelings that surface when listening to music, however, come straight from the deepest recesses of the listener's very soul; they are completely genuine.

One characteristic of music that supports the claim of music functioning as a paralanguage in The Law of Love is the presence of narrativity in musical scores. This narrativity is not the same as the narrative found in prose; according to Edward Cone, "If music is a language at all, it is a language of gesture: of direct actions, of pauses, of startings and stoppings, of rises and falls, of tenseness and slackness, of accentuations" (Nattiez 245). Music tends to be more abstract than concrete, but "the more representational the music the more easily are associations allowed, so that many listeners like to weave emotional dramas into what they hear" (Vernon 124). While music without intelligible words—or, indeed without words at all—cannot tell a concrete story, one can distinguish changes in tone and emotion. The rest is left up to the imagination. Nattiez likens this to the discovery of lovers' initials carved into a tree: no one can be

sure of the details of the "romance novel" inscribed there, but one can come up with a general idea and fill in the blanks. What matters most is the reader's interpretation: "The freedom of interpretation remains significant, for here the narrative exists only on a potential level, 'as a reconstruction by the person to whom the story is told or a projection by he who relates it…'" (Nattiez 246). In short, "listening to a work, we recognize the evocation of actions, tensions and dynamisms analogous to those for which the literary work is a vehicle" (Nattiez 248). Not everyone sees the same thing, but everyone sees something. This is certainly true during the flashback sequences of The Law of Love; merely by listening to the music and looking at the pictures, the readers can come up with their own explanations for the events witnessed, but not every interpretation would be the same. For example, after viewing Azucena's regression to the 1985 earthquake where Isabel killed the infant Azucena, most readers would be able to guess that the baby girl was first orphaned by some sort of disaster and then killed with a strange purple prism by an older-looking woman. But the details of the back-story (What caused all of the destruction? Who is the woman who killed the baby? Why did she do it? What was the prism for?) vary from person to person, until Esquivel's written account brings the individual interpretations together.

Musical and artistic media are commonly used in film to convey subtextual elements to the plot—for example, to underscore the action and create a mood of suspense, of fear, of jubilation or of desolation. It is said of The Law of Love that "in its interactive state, this novel is already nearly a movie" (Coonrod Martínez 893), so it would seem appropriate that it be accompanied by a 'soundtrack'. Movie soundtracks, in their classical use, were not meant "to function in isolation from the rest of the picture" (Flinn 38), but rather to mix seamlessly with the action and the dialogue to form a single, narrative entity. This is the role of the 'soundtrack' in The Law of Love, for in the flashback sequences image and sound unite as a single, multifaceted sensory glimpse into the characters' pasts. The details are clarified by the written accounts, but Esquivel reaches the reader's subconscious through the primal nature of the artwork and music. One can peruse the visual account of Rodrigo's murder of Citlali's baby and midwife while listening to "Senza Mamma" and without even knowing who the characters are or the overall significance of the scene, the reader can sense the congruity between image and sound and figure out that something is very wrong (in the plot, that is). The text that preceded the flashback, all the way at the beginning of the book, supports what the reader intuitively felt all along. And one might add that the musical accompaniment of this scene is particularly good, as the aria used is the lament of a grieving mother of a dead child, (like Citlali), who asks "Dimmi, quando in ciel potrò vederti? Quando potrò

baciarti?" (Tell me, when will I see you in heaven? When will I be able to kiss you?) (The Aria Database). In short, this is yet another example of how the music of The Law of Love tells a story that parallels the text…and of yet another way in which the music and illustrations perform a function of language by 'telling the story', in one way or another.

Without the addition of music and art, The Law of Love would still be able to tell the story of Azucena and Rodrigo and the others. Provided the writing was vivid and engaging, the story that would result would be complete in itself, and probably a good piece of literature. However, in order to create a truly innovative and appealing piece of literature, Esquivel would have no choice but to include music and art in addition to writing, which she did, producing the engaging novel that results. Without these elements, Esquivel would have created a story that would be functional, but somewhat one-dimensional and incomplete, because the artistic elements of this novel contribute experiences that could not be reached through the exclusive use of prose. With the emphasis on psychology, the unconscious and the power of art to influence human consciousness in The Law of Love, it is imperative that Esquivel demonstrate this power of interpretation by actually including art and music in the novel itself. In addition to supplementing the written text of the novel, the artistic and musical additions act as paralanguages, mirroring the written language in a more abstract, personal way. They alternately complement the written language, enhance its power and make up for its deficits. They fulfill all of the jobs of an orally based language and therefore can be considered paralanguages in the context of the novel. The result of the combination of so many different media is a novel that is a full-fledged multimedia experience, drawing the reader in to do so much more than read: look, listen, imagine. Laura Esquivel, in this respect, is more than just an author. Through her work with The Law of Love, she becomes a master craftswoman who takes the raw elements of language, art and music and turns them into a holistic literary experience.

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Pedagogical Strategies for Teaching Science in Secondary Schools

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Although teaching is not an easy task, by following certain pedagogical strategies in a secondary science classroom the teacher will be able to accomplish his/her main goal—to promote and ensure learning in an atmosphere conducive to learning. The following are pedagogical strategies that enhance and ensure learning: Bloom's taxonomy, differentiated instruction, constructivism, cooperative learning, the use of technology in the classroom, activities, assessment, and interventions. Benjamin Bloom formed a hierarchal system of thought processes. The order from the most basic level to the most sophisticated level is: knowledge, comprehension, application, analysis, synthesis, and evaluation. Differentiated Instruction is the method of giving diverse learners suitable instruction in a diverse classroom. Differentiated instruction takes into account the theory of multiple intelligences. Constructivism is a strategy that is key in a science classroom. The basis of constructivism is "hands on, minds on." Hands-on activities aid in relating the material being taught to real-life experiences. Cooperative learning concerns grouping. Grouping allows the students to interact and learn from each other while helping each other. Groups can be formed according to: level, interests, gender, etc. Another pedagogical strategy is using technology in the classroom. Technology can be a useful teaching tool if it is used properly. A main problem in teaching science in a secondary school is keeping the students interested and motivated. One way to accomplish this task is by using activities throughout the lesson. The activities should refer to the topic being studied in order for it to be effective and purposeful. The last two strategies include assessment and interventions. Assessment allows the teacher and student to observe that particular student's development and progress throughout the school year. The teacher can use formal assessment or informal assessment tools. Interventions are used when a student needs additional help studying a particular topic. Interventions can take place between students or between student and teacher. Using these pedagogical strategies to enhance learning in a secondary science classroom is beneficial in ensuring that learning is occurring among the students.

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I. Introduction

Teaching science in a secondary school can be quite a challenge. However, there are certain practices a teacher can follow in order to make teaching science both informative and interesting to the students. Many science classes are taught in a lecturing format. However, teachers have many more options than just straight lecturing. Two main challenges teachers face when teaching science is motivating the students and holding the interests of each and every student. Lecturing tends to not hold the students' interests for a very long time. Differentiated instruction and cooperative learning have proven to be very beneficial systems of teaching a class. Differentiated instruction allows each student to learn according to his/her own learning style. It is the job of the teacher to tend to everybody's different learning style. Cooperative learning groups, activities, and "hands-on" activities are key ways to hold the students' interest. These methods enforce active participation in a friendly and comfortable environment. The "hands-on" activities work to help students really know what science is all about. In this day and age technology is everywhere. It is in our homes, work, and schools. Therefore, teachers and students should take advantage of the technology in the schools today. Students can use technology to research information on the Internet, to write papers, to create fliers, and to use specific software programs that relate to specific lessons. A teacher should always be assessing the work of the students. When students need additional help with schoolwork the teacher should organize peer tutoring programs and small study groups. Although teaching is not an easy task, by following certain pedagogical strategies in a secondary science classroom the teacher will be able to accomplish his/her main goal.

II. Bloom's Taxonomy

Benjamin Bloom created a hierarchal system of learning (Figure 1). He believed that all learning starts with simple thinking and then the students work up to complex thinking processes (Handelsman, et al., 11). The lowest level is knowledge. Knowledge is the most basic level and most questions are asked at this level. At this level most students are able to memorize information but not fully understand the material. For example, a student learning goal at this level would be to list the organs of the digestive system in humans. The next level is comprehension or understanding. Comprehension is when a student is able to explain a topic in his/her own words. An example for a comprehension student learning goal is students will be able to explain the functions of the organs of the human digestive system. Next is the application level, where students are able to apply their knowledge to a particular situation. An example of a student learning goal at this level would be to understand the relationship between

digestion and nutrition. Analysis is the fourth step in the pyramid. This is when students are able to break down their ideas. An appropriate learning goal here would be to show the pathway of digestion. The fifth stage is synthesis. At the synthesis level students are able to build from the ground up. During the digestive system lesson students would, for example, create a cartoon of the digestive system. The students would have to create a character eating a talking French fry and throughout the cartoon the French fry could describe each step of the digestion process. The highest and most sophisticated level is evaluation. At this level students discuss their view points and answer questions. For example, after creating the cartoon, the students would present their projects. The projects would show each student's take and understanding of the digestive system.

III. Differentiated Instruction

Differentiated instruction is when the teacher divides his/her time and efforts among many students while giving all of those students worthy time. Differentiated instruction is giving diverse learners suitable instruction in a diverse classroom. Students in a differentiated classroom have different learning needs. Assessment is key to differentiated instruction. The teachers should assess student learning in class discussions, observations, tests, and projects. By assessing all student work the teacher will be able to get an overall idea of the students' needs. Differentiated instruction is centered on the students and can be used in group, class, and individual instruction (Tomlinson, 1-8).

Teachers who use differentiated instruction promote learning. By using differentiated instruction teachers are allowing students to express themselves in ways that are comfortable and appropriate for them, the students. For example, students might want to write essays, create a song, or make a painting as an assignment to show they are learning. This would be beneficial to the student since the student is able to use his/her skills in order to ensure learning. Students will also be able to express their ideas more freely this way.

There are many ways to differentiate instruction in the classroom. While differentiating instruction in the class there should be many different types of activities during the lessons. The different activities should be engaging. All students learn differently. Some students may be verbal learners, visual learners, artistically engaged, and others. These learning styles are biological and are based on features in the brain (Samples, 2000). Therefore, students should be allowed to express themselves in these manners according to whatever is more appropriate for them. Instruction should be created to give meaning and ensure learning. By differentiating instruction among the

students' skills, learning styles and interests the teacher is giving meaning to the lessons and ensuring learning since the lessons will be geared to fit the students' interests and skills.

Differentiated instruction is based on the theory of multiple intelligences. The theory of multiple intelligences was proposed by Howard Gardner. Gardner believed that everyone uses seven or more "intelligence," or learning styles. The seven intelligences are: linguistic, mathematical, bodily kinesthetic, spatial, musical, interpersonal, and intrapersonal intelligences (Gardner, 1993). Everyone learns in different ways and at different rates. All of these intelligences need to be equally valued in the classroom. For example, in a science classroom to focus on bodily kinesthetic intelligences the teacher can create a lesson in which the students have to act out mitosis. To focus on the musical aspect the students can create a musical tape to go with certain scientific processes. There are many options that teachers have when using differentiated instruction in the classroom.

There will be times, like in any other classroom, in which the teacher will assign the students certain work. However, with differentiated instruction there should be some occasions when the teacher allows the students to select specific assignments for the class to do. The lessons that are taught should be able to get the students to think critically in this environment. All assignments the students are given should entail student understanding and their applying the information in some form. Assignments should be given to challenge the students. If the assignments are challenging, then the students will have to use critical thinking to help them complete the assignment. Once the assignments are graded, the level of difficulty should begin to increase.

Teachers using differentiated instruction have different roles compared with teachers using traditional methods. Teachers of differentiated instruction do care about their students' knowing information; however, these teachers focus on observing and assessing their students. These teachers are in a way like the students' coach or mentor. Teachers of differentiated instruction have many different roles. These teachers must assess their students constantly and in many different ways. They have to figure out what each student's interest and learning style preference is. They must come up with different activities to help the students gather information, since using one activity all the time will just become boring for the students and they will lose interest in the lessons.

When teaching in a differentiated classroom the teacher must possess some leadership qualities that will help him/her successfully teach and work with these students (Tomlinson, 16-20). The teacher must be organized. The teacher has to be able to look at students individually and figure out what their interests are and how they learn best.

When doing this the teacher has to train himself/herself to not make first impressions without getting to know the student. The teacher should share responsibility in the classroom with the students. As a teacher of differentiated instruction he/she works with students as a class, but also individually. The teacher should want every one of the students to succeed; for this to happen, the teacher must spend time with the students on an individual basis.

In a differentiated class the students should be able to "grow" in knowledge, skills, and dispositions. In a differentiated class the teacher focuses on knowledge, skills, and dispositions in a separate manner. The teacher might focus on the student's learning certain material. Then the teacher might look at the different learning styles the student possesses and focus on the skills that student will be able to use to succeed. By looking at the student's dispositions and values the teacher will be able to get an overall idea of the student's character. In the end, knowledge, skills, and dispositions will come together as one to help the student "grow."

Differentiated instruction is being able to split the time among all the students and focus on their different learning styles as an advantage point. The teacher should incorporate activities that focus on all of the different learning styles. By doing this the teacher will help the students excel in their strengths and better their weaknesses in the other learning styles. For example, if the teacher plays a short film during the lesson the students that are visual learners will succeed and the students that have other learning styles, such as mathematical and musical will be able to practice and better their visual skills. Using the natural skills that the students might possess will help them succeed and feel more comfortable in the classroom. Differentiated instruction also raises students' test scores and helps students to actively participate in class discussions and activities (Mastropieri, et al., 2006). All students can learn from one another and all students should appreciate the diversity among each other.

IV. Constructivism

In the education field there are several theories that support how children learn best. One theory is constructivism. Constructivism is when knowledge and understanding are used to make an experience clear. Constructivists feel that children learn best when they become actively engaged. Students can become actively engaged through "hands-on" and "minds-on" activities (Glanz, 41). The theory states that students learn best when they are able to form or construct meanings on their own. This does not mean that the teacher does not serve as a critical role in the classroom. The teacher is there to help the students in any way possible.

There are certain characteristics that set the foundation for constructivism. These characteristics include: activating prior knowledge and building on it, identification of whole major concepts, understanding of new concepts, using knowledge in school and to solve real life situations, and metacognition. Metacognition is referred to as knowing what you know. Metacognition is used in learning situations. This concept involves dynamic control over one's own thinking. Examples of metacognitive skills include: observing comprehension, "thinking-aloud," and planning how one will accomplish a particular learning task (Wikipedia). William Glasser was a constructivist who firmly believed in the "hands-on" approach of teaching. William Glasser stated:

"We learn…
10% of what we read
20% of what we hear
30% of what we see
50% of what we see and hear
70% of what we discuss
80% of what we experience
95% of what we teach others."

There are different teaching tools in constructivism that help students become actively engaged. The computer and other forms of technology all serve as tools that aid in this process. By using the computer the students are performing "hands-on" and "minds-on" activities. Another key point of constructivism is that students learn how to deal with real-life situations. There are certain computer programs, such as simulation programs, that can offer students a chance to act like they are part of the situation and setting of the program they are using.

Laboratory work is also a very beneficial "hands-on" experience that the students can learn from. Lab work consists of students' putting their knowledge to work. Usually once a week students are brought to the lab to practice their skills of information they learned in the classroom. For example, when students are taught about the systems of the body a dissection of a frog would normally be completed in the lab class. By completing the dissection the students are experiencing first-hand what the specific body parts function as and what they look like. In the seventh grade class in which I was working, Mr. Vassilatos took the students outside on a nature walk. The students were learning about different types of plants and, since it was still nice out and Petrides has so much land, Mr. Vassilatos took the students outside. The students were able to observe the different trees around the school grounds. Each student had to create a nature walk journal. In the journal each student wrote about what he/she observed, such as what the

tree smelled like, if it had cones, the size and shape of the leaves, and what the bark was like. The students also gathered leaves from the trees and pressed them in their journals.

Science fairs are also examples of "hands-on" activities (Prattis, 2006). Each year in the seventh grades the students work either individually or with a partner to create a science project. The students pick topics that interest them. They are given a few weeks to perform their experiment and they then have to report their findings. The students who excel in their presentations move on to citywide and statewide fairs. During these fairs other students and science teachers are able to observe the projects and question the student on his/her findings. Science fairs tend to grab the interests of the students performing the experiments and the students watching the presentations.

V. Cooperative Learning

Cooperative learning concerns the use of grouping in the classroom. There are different elements that play a role in cooperative learning (Manning, et al., 1991). The first is positive interdependence. Positive interdependence indicates the success of the group; the group members have to depend on each other. All group members must participate. The success of the group is in the hands of the group. The next element is individual accountability. This is when the teacher makes sure that all students participate in the assignment. Group processing is the third element. Group processing is when the group gives feedback on how well the members work together. One cooperative learning activity is "Simple Jigsaw." This activity incorporates the three different elements of cooperative learning. The teacher does the first step of the jigsaw. The teacher breaks down a specific topic into three-to-five smaller topics. Then the students are broken up into groups and each member is given one of the three to five smaller topics. Each member is accountable for researching and reporting the information they have found on their topic to the rest of the group. The group as a whole is then responsible for learning and organizing all of the material so it can be presented to the class.

By participating in cooperative learning groups the students gain better social skills, which is the fourth element. By contributing in group work students learn respect, cooperation, and better listening skills. The final element is face-to-face interaction, in which students interact with one another. Research has proven that cooperative learning increases self-esteem, causes higher achievement levels, causes an increase in class participation, and causes greater enjoyment of classes and attending school in general (Lin, 2006).

The groups should always be relatively small, about two to six people in each group. The teacher can create the groups according to gender, ethnicity, ability, interest, or just counting off. For gender the teacher can either group the students into groups of just females, just males, or a mix of both females and males. For ethnicity the teacher should mix the students so that the ethnicities are different in all of the groups. By having a few different ethnicities in one group the students will be able to learn from one another based on different cultures and race. Groups formed according to ability tend to be the most beneficial. Groups should be formed with students of lower abilities and students of high achievement levels. By mixing the students in this fashion the higher achieving students can help the lower achieving students, almost as in peer-tutoring sessions. Grouping students together based on interests can be an advantage and a disadvantage. Grouping all of the students with the same interests together can work well since all the students have a greater chance of getting along. However, the students may get along too well and they may just be mischievous if they are all seated and working together. The teacher can also rely on the old system of counting off. For this method each student would get a number of one through five and then all of the one's work together, all of the two's work together, and so on.

VI. Technology

Throughout the years there have been many advances in technology. Technology is in our homes, at work, and now even in our schools. Schools have adopted technological principles. There are computers, printers, software, projectors, and overhead projectors in many of the schools today. However, not every school takes advantage of the benefits technology brings. In Oversold and Underused, the author, Larry Cuban focuses on technology in schools in the Silicon Valley of California. After doing research from 2000-2001 in preschools, elementary schools, high schools, and even universities, Cuban found that in many schools, teachers and students have access to computers; yet, many of the teachers refuse to change their traditional ways and they did not start using computers (Cuban, 73). Many teachers found that lecturing suited them better then teaching with computers. This was true for not only schools in California, but everywhere in the United States. At Petrides, each student and teacher has his or her own laptop. However, not every student uses his or her laptop. Some students chose not to use their laptops because they do not want to carry them. The students that do use their laptops use them to take notes during class. As for the teachers, I have observed that the only times many teachers have used their laptops is to record grades. Of the four different classes that I have observed at Petrides, I have seen only one teacher use the

computers for group projects and as a teaching tool. In the seventh grade classroom that I was observing, the students had to create PowerPoint presentations once a month based on a topic they were studying. The teacher also declared Fridays as technology day and every Friday the students would research specific topics in class and then use the projector to display their findings to the entire class.

The number one form of technology that is used in schools is the overhead projector. The overhead projector is very useful to teachers and is simple to use. Teachers do not have to put a lot of time and effort into using an overhead projector; whereas with computers the situation is different.

Larry Cuban (2001) also believes that technology will eventually become a huge part of the school system. Cuban stated that promoting and using a great deal of technology in schools will take some time. More and more schools are beginning to have a greater access to computers and appropriate software. There are many different types of computer programs that should be used in schools. One such program is a drill-and-practice program. This program serves as a good reinforcement tool in the class, since it allows students to practice skills they have already learned in the classroom (Roe, et al., 164). Another beneficial software program is a simulation program. Simulation programs replicate real-life situations. In science classes these programs can be used to show and teach virtual dissections. Simulation software allows the students to explore areas, such as the bottom of the ocean floor or inside of the human body, without ever going there. This form of software also gives certain situations and laboratory exercises for the students to work on. Some of these situations include cleaning oil spills, forming curing strategies for sick animals, and performing research work in distant areas. All of these situations would be too dangerous for the students to be faced with and impossible to accomplish in the classroom. Computers can also be used in the classroom to do research work on the Internet, to make flyers, to write papers, and to create timelines. With all of the advances in technology today it seems as though the future is looking bright for technology in schools.

The computer can be a very useful tool in the classroom when used correctly. Teachers should use software in the classroom that is age appropriate and topic appropriate. The tutorial and simulation programs are very useful when it comes to showing the students things they might never see in their lifetime. These programs also allow students to work with certain materials that they may never have a chance to use hands-on. Technology is an important tool that students enjoy and can use to their advantage.

VII. Activities

Two of the main challenges of teaching science in a secondary school are getting the students motivated and keeping the students' interests. Having the students perform activities during the lesson will help keep their interests and also help them focus on specific material. One activity is the double-entry notebook/journal. This activity can be used a tool to help students understand scientific journal articles. Most scientific journal articles are not written at a middle school or high school level. Therefore, when the students are assigned to read these articles it may be very difficult for the students to actually comprehend what the article is about. To set up the double-entry notebook/journal each student should fold a piece of paper in half to create two columns. The first column should be labeled "text" and the second column should be labeled "response." In the text column the students are to write down important notes from their readings. Then in the second column the students should write what each statement means. They can either write comments, questions, feelings, or even draw an image. The second column is mainly used to help the students break down and understand key points in the article. These journals can be shared among students and teacher. The students should have friendly discussions about what they wrote in their journals. These discussions would allow the students to share their different viewpoints on the articles. The discussions would also allow some confusing points to be cleared up; chances are if one student is confused about a certain point then other students may also be confused.

Students in science classes tend to struggle with the vocabulary of certain lessons. Many of the students are usually not familiar with the words that are being taught in middle school and high school science classes. Therefore, "How Well Do I Know These Words?" is a very beneficial vocabulary tool. The students should fold a piece of paper into three columns. The first column should be labeled "I need help finding a meaning for this word," the second column should be labeled "I think I know the meaning," and the third column should be labeled "I know a meaning." The students can do this for every chapter they are taught. Whenever they come to a word they do not know then they should use this table. This table will help keep the students organized and they can use this as a helpful study tool. The use of this table also allows for the students to use different processes, such as knowledge and application.

Four corners is a cooperative learning activity. For this activity the teacher places four different topics in the corners of the classroom. Then the teacher can break the class up into four groups of about five students in each group. Each group receives a different color marker and the four groups are to start in different corners of the classroom. Each group is to write down some information under the topics. This activity

is timed. The activity ends when each group has written something on all four pieces of paper. When the activity ends the group picks a leader to report what the group wrote on each paper. The following is an example of how this activity can be used when discussing AIDS. In each corner of the room there will be a transparency with a topic on the top. These topics include: symptoms, how you get AIDS, treatment, and prevention. Each group will get a different color marker so the teacher knows what group wrote what. The students are to use their textbook and/or Internet to obtain information on these topics. The students will get three minutes at each station to write down as many different points as they can. When time is up the groups move clockwise to the next corner. After each group has written on each transparency the transparencies will be placed on the overhead projector and each group leader will explain what they wrote. The teacher should help the students if they need it and he/she should fill in any missing material that the students did not talk about.

The final activity is an activity that is used throughout the entire school year. This activity is called "metacognitive conversations"(Creech, 2006). This activity consists of the teacher and student having to "think aloud" when reading graphs, notes, and lab work. Students would then have to write any questions they have or any topic area that confuses them in "metacognitive logs." This assignment would be very beneficial in a science classroom. "Think aloud" is when the teacher reads through specific material out loud while explaining it in depth. This technique is very beneficial to the students since this technique can clear up any confusion one may have. Science articles and other materials can be very hard to understand if one is not already aware of the terms. Therefore, if the teacher goes through an article part by part and "thinks aloud", the students may understand the key concepts of the part better then if they were reading it on their own. Once students are aware of how to "think aloud" the class can be broken up into groups and the students can "think aloud" for themselves, while being guided by the teacher.

VIII. Assessment

Assessment is a key part of student learning. Assessment allows the teacher and student to observe the students' development and progress throughout the school year. There are many ways the teacher can assess his/her students. There are formal means of assessment and informal means of assessment. However, whichever form of assessment is being used the teacher will be able to evaluate the progress and growth of the students' learning abilities.

Standardized tests are an example of formal assessment (Ornstein, et al., 332-348). Experts of a particular field of study create the standardized tests. These standardized tests work to test the students on set material. There are also set ways for these tests to be graded and interpreted. The material that is on these types of tests is usually material that should have been taught to the students all year round. The teacher has a general idea of what the test will be like from previous years of administering the tests. Therefore, the teacher is able to greatly prepare the students for this test. Standardized tests are used to measure how much the students have learned throughout the course of the year. However, standardized tests cannot be the only form of assessment used in the classroom since there are some students that might do extremely well in the class; yet, when it comes to a standardized test that student may get too nervous and do awful. While observing a seventh grade science class at Petrides the students had to prepare for the state laboratory test. For this test the students had to complete certain experiments and answer questions following each experiment. In the lab the teacher, Mr. Vassilatos, had set up four science experiments that resembled what the test might look like. However, the experiments were not exactly the same since that is unlawful. The experiments were set up and there were questions that had to be answered. The students were given a sufficient amount of time to complete and practice the experiments. Mr. Vassilatos had the students do the experiments over and over, so that by the time the test came the students were very well prepared. Other examples of standardized tests include: ITBS, state math and science exams, and the SATS.

Besides formal assessment tools there are also informal assessment tools. Examples of informal assessment tools include: teacher-made tests, projects, rubrics, and portfolios. To test specific content knowledge the teacher can create tests. These tests are developed so the teacher can examine the progress and understanding the students have concerning a specific topic (Ornstein, et al., 348-349). In the seventh grade class at Petrides that I had been observing, I have witnessed the teacher give several tests. The day before each test Mr. Vassilatos gives the class a review. These review sessions consists of Mr. Vassilatos writing key questions on the board and then going over the answers with the class. During one of the review sessions Mr. Vassilatos told me to never give students a test as a form of punishment and to never test the students on material that has never been taught to them. He said that tests should be given on the material the students know so that they do well on their test and the test will then act as a reward. Teachers can also give tests before they start teaching a specific topic, to see if the students have any prior knowledge in that field of study. These tests should not be

graded, yet they should be used only as resourceful tools to help the teacher focus on what mainly needs to be taught in the classroom (Doane, 2006).

Mr. Vassilatos also assigned the class many projects to be completed during class time. I have observed the students working on several PowerPoint presentations, in which the students must create 30 slides on a particular topic. Then after the students completed their projects they would present them to Mr. Vassilatos, who then graded the projects. These projects were given to help raise the grades in the class. For presentations it is helpful if the teacher creates a rubric. A rubric is used to aid in the grading process. The rubric tells how many points are given to certain material that is in the project. A rubric gives a detailed description of what should be included in the project. When the teacher uses a rubric for grading, the rubric should be handed out to each student before they start their project so that way the students know exactly what is expected of them. The rubric is a very important and helpful assessment tool.

A final example of informal assessment is a portfolio. A portfolio is a collection of student works (Ornstein, et al., 393). Each student receives a portfolio in the beginning of the year and these portfolios are to remain in the classroom. Different projects, tests, rubrics, and teacher notes are added to the portfolio throughout the course of the school year. The main purpose of having a portfolio is so that the teacher, the particular student, the student's parents, and other authority figures are able to check the student's progress and improvement rate.

Assessment is a very important part of the learning process. The main role of assessment is to check for understanding and see what the students are grasping. Assessment can be performed through tests, activities, and teacher recordings. There are many different forms of assessment. In a classroom the teacher should sample different forms of assessment and see how effective each method is. Once the teacher sees what forms of assessment works for him/her and the students, those are the methods that should be used.

IX.Interventions

There will be some instances in which certain students will struggle in school and need additional support. There are several ways a teacher can intervene and offer the student extra study help. Some examples of interventions are: teacher-student conferences, peer tutoring, and individualized tutoring sessions.

Teacher-student conferences are when a teacher and a student meet to discuss matters associated with school (Daniels, et al., 190-191). During these conferences the teacher is usually able to learn more about why the student does certain things. The

teacher is also able to help the student with certain things and learn more about the student as a person. In one of the classes that I observed there was a student who was at risk of being left behind for the third time. Since the teachers did not want to see this happen again they had a conference with the student. During the conferences the teachers and the student came to an agreement on what they could do for the student and what the student could do for the teachers. To prevent this student from failing, the student had to make copies of all of his tests and notes and give them to each teacher. Then all the teachers met together and they observed the student's materials and saw that he was doing the work and he was trying. By gathering all this material the teachers agreed to pass the student and he was promoted to the eighth grade.

Peer tutoring and tutoring sessions are relatively similar in that they both concern tutoring projects for students in hopes that they may excel in an area they struggle in. Peer tutoring is tutoring between two students in the class. The teacher will normally assign one student who tends to excel in class to tutor a student who is struggling. The peer tutoring is performed under the advisement of the teacher. Tutoring sessions tend to be between the teacher and the struggling students. Tutoring of this nature can be either individualized tutoring or group tutoring. These tutoring sessions are at the discretion of the teacher.

X. Conclusion

Teaching science in a secondary school is not an easy task. However, knowing certain strategies that will enhance the learning process in the classroom is greatly beneficial to the teacher. Research has shown that differentiated instruction and cooperative learning can enhance learning by making the school atmosphere more comfortable for the students. In these settings students are able to actively participate and enjoy their classes. In a science class it is very important for the students to have "hands-on" experiences, use technology, and perform other activities. These activities will hold the students' interests while also helping them learn difficult material. The teacher should always assess the students and offer any additional help possible. As much of a challenge as it is to teach science in a secondary school, the teacher should always want his/her students to succeed and that teacher should do everything in his/her power to accomplish that goal.

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Benjamin Bloom created a hierarchal system of learning that shows all learning starts with simple thinking, knowledge, and then the students work up to complex thinking processes, evaluation.

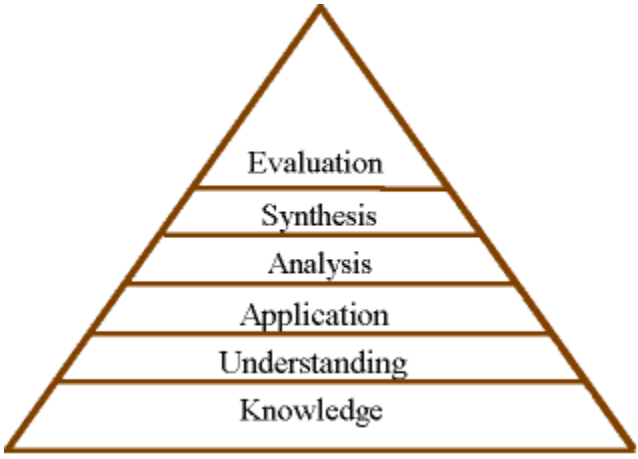

Figure 1: Bloom's Taxonomy.

Hiding the Issue: Generation over Race in *Guess Who's Coming to Dinner*?

Holly Walker (English)[1]

Have you ever watched a movie for its publicized topic, but found it to focus on something else completely? It might have taken its cue from *Guess Who's Coming to Dinner* (Stanley Kramer, 1967)—one of the most misleading "controversial" movies of film history. Instead of showing the audience the issues behind interracial marriage in the 1960's, it shies away from the main topic and instead focuses on the White father figure and how difficult it is for him to come to terms with his daughter's impending marriage. The subject of racism is repeatedly pushed aside, as Matt Drayton (played by the ailing Spencer Tracy) questions his daughter's intention to marry. *Guess Who's Coming to Dinner* takes a weak stance on the heated topic of interracial marriage by hiding behind the issue of the generation gap between parents and their children.

The film was released in 1967, when the Civil Rights Act of 1964 was still new and many of the audiences in America were still primarily White. The film is criticized in terms of today's standards of civil rights, and in comparison to today, the stance is truly extremely weak. However, there was still a lot of tension between the races. For example, there was a race riot in Detroit during the summer of 1967. Nonetheless, the movie received an Academy Award nomination for Best Picture.

The film does not address racism straight on, but instead weaves around it in a series of polite conversations and strained looks between characters. According to some critics, "Because of the 1960's 'generation gap,' the film's message of reconciliation between the young and old is as central as its message of racial tolerance; in fact the two are connected" (Vera and Gordon 87). They are connected, but the generation gap takes the forefront and is the cause of resolution, and that makes the film weaker on race than if it had faced the heated topic of the time head on. With Sidney Poitier in the film, many viewers expect there to be a strong stand against the racist views of interracial marriage, but Poitier's character barely gets a chance to take one because the other characters are facing a crisis of change, and do not want to hear what he has to say. Matt implicitly cuts him off when Poitier's character, John, begins to tell Matt what he thinks about the

[1] This paper was written under the direction of Dr. Kim Worthy (Writing Center) and Prof. Andrew Needle (Art) for the Freshman RFT: Media and Persuasion.

situation. Poitier is well known for social activism, but he is not given the chance to make a stance against the stigma of interracial marriage because of the limitation of his character, and because of the focus shift that takes place when Matt Drayton enters the film.

John is portrayed as a Black Superman. He is a doctor with many honors and has accomplished much in his short life span. He is a widower, but still able to love. However, these attributes of his character considerably weaken the message of the film, because he had to be raised to that level even to be considered as a suitable husband for a White woman. Recently there has been research into interracial marriage and higher education and results state that,

> Though further study would be required to provide conclusive evidence, all indications point to the fact that as Blacks move up the educational ladder they are more likely to attend schools in which Whites are a majority or are present in large numbers. More than 80 percent of Black college students attend a predominantly White institution. These students are far more likely to have contact with Whites, to make White friends, and to find a non-Black marriage partner. (Tucker and Mitchell-Kernan)

This explains John's initial willingness to marry Joanna, though because of the time period his hesitancy increases once he is faced with her parent's ideals. Matt has no problem accepting John as an intellectual equal, and if he had met him through business, as is shown through their long talk on the terrace that spans many topics. They are the ones to introduce the generational differences here, when they talk of the young people and their dancing, and Matt notices that the Black kids are better dancers. This conversation provides a link between racism and the generation gap; Matt notices the dance but does not understand. John does, and so he is placed in the middle between the aging generation and the youth that is portrayed by Joanna and Dorothy, the young Black assistant to the Draytons' maid, Tillie. This is also where the focus draws away from John and Joanna and towards Matt's displacement in the world he thought he knew.

Unlike Matt, the wives in the movie are more accepting, but only because of the passion between the John and Joanna. However, besides a kiss shown only through a rearview mirror in a car, the couple displays very little passionate affection towards each other. Matt's wife Christina (Katherine Hepburn) emphasizes that their daughter "Joey" seems in love with John, but the couple's screen time together is limited and they are always very chaste towards each other. The audience has to rely on Christina's and Mrs. Prentice's acknowledgment that there is a strong connection between the lovers, because there is no visual authentication of the acclaimed ardor. In fact, one suspects it is

repeatedly mentioned by the older characters, including the mothers and the priest and family friend, Monsignor Ryan, because there is no other evidence of it. Yet it is their "passion" that Matt bases his final decision on. By not showing the intensity of their love for each other, the film reduces the impact of the message that interracial marriage is acceptable and right. It is hard to identify John and Joanna as a couple and as usual, with Hollywood movies of the time, the film dances around the subject of racism. The absence of passionate embraces between the couple suggests that if John was portrayed as a sexual being, he would become what American White men supposedly feared—Black men lusting after White women (a cinematic stigma since D.W. Griffith's 1915 *Birth of a Nation*); however, by reducing his sexuality, the film makes Matt, and White American viewers, more likely to accept John as a suitable husband for Joanna. John's character is essentially castrated by the absence of a sexual presence. Although the film begins to touch on the subject of sexuality between the couple, it is immediately quieted by Joanna when she assures her mother that they have not been to bed together yet, because John did not want to. The first on-screen interracial kiss is severely played down by its portrayal in the film—as noted above, it is shown through a rearview mirror, much to the disgust of a White taxi driver.

Tillie is another Black character reduced in importance because she is the single racist voice, and is the only person on the Drayton side that tells John that he does not belong because he is going "above himself". The members of the family ignore what she has to say, even though it is extremely derogatory to John. She is shown as merely being "traditional," preserving opinions of the past. In this regard, she is a mirror to Matt, except that she is used to portray the dual thoughts of the time period in terms of race: that Blacks are as racist as Whites, and that Whites are superior to Blacks. In addition, she is a foil to upper middle-class John as a working class Black woman who speaks with bad grammar and calls him "boy" when no one else can hear. Her respect for the younger generation is lacking, and she expresses her thoughts easily. As Matt points out, she "stirs up a lot of trouble." Tillie is the only character that does not try to be polite in reaction to John and Joanna's relationship. She voices her disapproval to anyone that will listen, although no one pays any attention. Her remarks are ignored, and Joanna even goes so far as to laugh it off and say, "I've always loved you, and you're just as Black as he is. Why would it be wrong for me to love him when I love you?" While this is an obvious salute to Joanna's colorblindness, it is a hypocritical approach to Tillie's character: she is seen as part of the family, but her voice is largely unheard and her comments are pushed aside. Tillie's abuse of John while he is undressed is shot with a high-angle frame, unlike any

other scene in the movie, visually showing her powerlessness, and is one of the few scenes that show passionate emotions from the characters.

Tillie calls John derogatory names that if said by any other character, would be considered extremely racist, but these are largely ignored because the only people witnessing her verbal assault are also Black, and John is too polite to bring it up to the Draytons. Critic Thomas Wartenburg states that Tillie is the link to the time period:

> Ironically, *Guess Who's Coming to Dinner* fastidiously avoids contextualizing its won politics, placing the only two references to the tumultuous racial struggles of the 1960's in the mouth of the White couple's maid, Tillie. Both comments are sarcastic references to that context (Wartenburg 114).

With the film's main characters avoiding the issues of the times, the only ways they connect to the time period are through the most ignored character, and even then they only make the references to her words in a sarcastic tone. While Tillie is the only person allowed to make racist comments, she is also the only character that can mention the civil rights movement without seeming condescending. Tillie is the strongest racist in the film.

The exploration of the generation gap is more thorough than that of interracial marriage. According to Margaret Mead, generational differences are important. "The more intense the experience of generational change in the family and of social in new groups, the more brittle the social system becomes and the less secure the individual is likely to be" (59). Matt is certainly portrayed as insecure, and the film plays off of the older audience and their confusion over the changing times.

Matt Drayton is shown as a liberal political activist before he even comes on the screen, through comments from Joanna and the picture of FDR on his desk placed next to his wife and daughter, signifying a sense of family connection to the president best known for liberalism. Matt is presented as intelligent and not the least bit racist. He takes Tillie's words of warning to heart when she tells him there is trouble in the house, and rushes outside to see the problem, indicating that he has complete respect for Tillie as a human being and not as a servant. His fairness is completely intact during his entrance, as he greets John cordially after he understands that there is no danger to his family—the illusion is only shattered once the reality of the situation hits him and he realizes John's purpose in his home. He continually loses credibility as a liberal as the movie goes on, with his comment after backing his car into a young Black man's car, "What the hell is it today? Less than 12% of the people in this city are colored people. I can't even have a dish of Oregon Boosenberry without runnin' into one of them." His previous standing as a fair minded and unprejudiced man is compromised by this comment because it illustrates just how unaffected he was by the civil rights movement, and he becomes exponentially

more irritated the more he is affected. This makes him appear extremely hypocritical, especially in the eyes of his daughter Joanna, who believed him completely incapable of having a problem with her marriage. He is persistent in his belief that the marriage will not work out even after he is provided with evidence by the Monsignor that it is possible for interracial marriages to flourish, and it is only when he is told that he is too old to understand how they feel that he changes his mind.

By making Matt hypocritical, the film is suggesting that White liberal men would change their minds about integration if it occurred in their own homes. Matt is the main cause of the film's weak stance on racism. From the moment he enters the film, there is a shift in focus away from the couple and towards him and his struggle to adapt to a changing world. The film's intended climax is Matt's decision, but by the time he makes up his mind, John has emerged as a stronger character through the battle with his own father. Yet Matt undermines John's transformation from meek to angry by cutting him off and sending him into the family room to hear his verdict. John obeys, and this is commented on by critics of the film:

> The Black father-son struggle…displaces the primary Oedipal struggle in the film, which is that of Dr. Prentice versus Mr. Drayton. Dr. Prentice will marry despite his father's objections, but he will not disregard Mr. Drayton's objections. He gives more weight to the opinion of his prospective White father-in-law than he does to that of his own [Black] father (Vera and Gordon 94).

Matt is the most powerful character in this film because of the weight he carries over the prospect of John and Joanna's marriage. By taking away John's power, the film weakens him. While John is obviously more educated, he is helpless by his own making. John willingly relinquishes his power into Matt's (older and presumably wiser) hands.

The figure positioning of the Prentices in the car ride home from the airport is foretelling of the interactions for the rest of the movie. In the back seat, the Prentices are separated by the younger generation and are put into the background. The Prentices are not as respected as the Draytons when they are introduced. John is afraid to tell them that Joanna is White, and so the audience is prepared for their reaction once they do see Joanna. They are still shown as important, but Joanna and John have the control even though they are separated by his parents. Mrs. Prentice's close vicinity to Joanna and her willingness to start conversation indicates that she could accept Joanna's place in her life. Mr. Prentice however, leans away from Joanna, as he did when he first met her in the airport. Mr. Prentice is a more influential version of Tillie and is another Black racist that thinks that John is overreaching himself. He is the only person that excites John enough to make him react. The most passionate scene in the film is when John finally stands up

to his father. This scene is key because it is the climax of the movie, but it barely touches the idea of racism, although it is still the strongest scene about it. However, it only involves two Black men, and does not address White racism at all. The only spoken, accusable racists in the film are Black, and they are effectively silenced by the end of the movie.

In the beginning of this scene, Mr. Prentice towers above John while he berates him for the sacrifices that his parents made to make sure he lived a decent life. John is calm and silent, and does not appear to be affected by his father's words. When Mr. Prentice tells John to "stop and think," John is already in the process of thinking. His body language is relaxed, but the profile shot of his face shows that he is tense while he listens to the words of a past generation. He doesn't look his father in the eye until he is ready to speak, and his hand gestures are violent, betraying what he's feeling. When he finally speaks his mind, he takes the position above his father and gains control. However, although John has finally become passionate, he backs down when he reaches his peak, walks away for a minute, and then apologizes. This moment epitomizes the entire film; it starts to make a point, then backs away and softens the message by hiding behind the generational issue. This film should be filled with moments of characters bursting with emotion, but instead takes the polite approach and calms everyone down, save Tillie, who is ignored.

Dorothy is a minor character, but she serves several purposes. Besides assuring the audience that John is not solely attracted to White girls, she is another example of youth that does not notice color, like Joanna. Most of the youth in the film ignore race entirely, and so the battle of racism falls entirely to the elder generation and diminishes it greatly. By focusing it in one age group, there is a singular view on it, and the issue becomes one-dimensional and easily put aside in favor of addressing the difference between the ages. Dorothy provides a bridge to the outside world of youth by leading the audience outside to the Black delivery boy, who calls her "doll" and offers her a ride. However, he turns his back to Tillie and answers her rudely when she comments on the quality of the meat he delivers. Tillie is automatically the outcast in this scene, and she looks on disapprovingly when Dorothy leaves with the delivery boy. The elder generation is thus alienated by their racism, and this is also evident in the drive-through diner scene.

The only instance of a Black man expressing rage against a White man is when Matt hits the young Black man's car in the diner parking lot. However, the anger is clearly not induced because Matt is White, but because he is old. The young man says, "These old men, they're senile," and repeats throughout his fit that Matt is an old man. The fact that this young man is Black is overlooked because he does not refer to Matt as

White, simply as old, once again focusing the generation gap and ignoring the issue of racism. The entire diner scene draws away from the intended purpose of the movie and "who's coming to dinner," and brings the focus back to Matt and his struggle with connecting to youth.

The issue of interracial marriage was and still is an issue that garners strong reactions from both sides, but this film takes this charged issue of the time and places a bland, courteous screen in front of it so that most of the dialogue is strained, but calm. As Vera and Gordon observe, "The only Black rage in the film is Black against Black—Tillie versus Dr. Prentice or Dr. Prentice versus his father—a convenient displacement" (96). The film would not maintain its tone if any of the rage was directed towards a White person, but it would have carried more weight and added realism appropriate to the time period. When John begins to direct his anger towards Matt, he is cut off by the elderly White man and ushered in to listen to Matt's decision in what is called the climax of the movie. This "climax" carries almost no emotion, other than Matt's off beat commands to Joanna to "shut up." It only reiterates the power that Matt has over the film and its characters.

Matt holds all of the power at the end of the film where he makes everyone sit down so they can hear his opinion on the marriage. In this scene he emerges as the full-fledged male patriarch that has absolute say on the ending of the film. At the start, John is standing with him, but Matt makes him sit down with Joanna, once again taking the power away from his future son-in-law. When Matt mentions Tillie, he remembers that she is a part of the family, something that he forgets momentarily while she is in the kitchen, absent from the film since the Prentices arrived. Even though Matt brings her into the circle, he keeps her on the outside, so while it is still apparent that though she is a member of the family, she is lower on the social scale than their possible future in-laws. As Matt recounts the day's events, everyone stares back at him without responding. He has no opposition, and when Joanna ventures to speak to John, he tells her to shut up so that he can assume the mantle again. He bypasses the talk of racism quite easily by stating that he was flabbergasted at the marriage, but the only issue that he will actually respond to is the accusation by Mrs. Prentice that he is a "burnt-up old shell of a man." He effectively ends the importance of race in the marriage and instead makes the entire intended climax of the movie about how he has connected with his own youth once more, and overcome the generation gap that he has struggled with since his outburst at the drive-through diner.

Matt in this scene also refutes John's dependence on his opinion of the marriage, knocking John down a little more, and says that the only importance is "what they feel,

and how much they feel for each other" even though, as stated previously, there is no concrete evidence in the film of the level of their passion towards each other. Matt does not add that John shouldn't have placed all of the importance on their marriage because they were a White family with money; that would have connected the film back to the original issue of an interracial marriage. There is no music in the background of this scene, and the silence is powerful as everyone waits for what Matt is going to say. When Matt finally addresses John and Joanna and brings up the issue of racism he says, "But you're two wonderful people who happened to fall in love and happen to have a pigmentation problem." Even though he is directly talking about their future problems because of the color of their skin, he still manages to downplay it by calling it a problem. If he had completely turned around in his opinion about interracial marriage, he wouldn't see it as a problem at all. The scene ends happily enough, with tears in the eyes of the women, and Matt's gruff call to Tillie about dinner. The build up that occurred for the entirety of the film is released in an anticlimactic speech that barely addresses the topics presented at the beginning, and ends up being more about Matt than the problems that the couple will face.

The film relies heavily on dialogue to push it forward, evident by the lack of music played in the background throughout. There is only one lyrical song that is present, an old favorite that is replayed several times throughout the film. It first occurs in the opening credits and foreshadows the problems the couple will face by the opening stanza,

> You've got to laugh a little/Cry a little/Sometimes let your poor heart die a little/ That's the story of/That's the glory of love.

This song's repetition gives heightened importance to the fact that John and Joanna have to "live a little" to have the glory of love, as Matt and Christina have. The opening credits are accompanied by an upbeat song about love that turn into John and Joanna happily navigating their way around the airport and weaving between children on the stairs. The music stops when they arrive at Joanna's home, and the focus lies on the older generation. There are only three instances of diegetic music (music coming from within the story world) used in this movie, and they only occur around young people who do not show respect to their elders. The young delivery man sasses Tillie when she blames him for the poor quality of steaks and he takes no responsibility for it. This scene seems out of place in the movie, in part because of the introduction of such out-of-date music and also because of the exaggerated youthful attitudes presented. The second occasion of diegetic music is at the drive-in, where Matt and Christina look completely out of place among young people eating in the back of their cars. Matt is uncomfortable with the differences in society outside of his home, and the old-fashioned music adds to the strangeness of the

scene especially because most of the film is strictly dialogue. And lastly, the singer at the bar where John and Joanna meet her friends also sings about "the glory of love." Music is strongly connected with youth in this scene and transcends race. Black and White youth enjoy the same music, and so they are connected and race is eliminated through music, but it is completely out of tough with the real music of that generation, which was rock and roll. The last occurrence of the lyrics is in the closing credits, with a repeat of the opening song. This repetition is mirrored in John and Joanna's intent to be married and Joanna's certainty that everything will work out because they are in love. The parents, previously shown in this scene with nondiegetic music, are assimilated into the world of their children through the old melody about love.

Sidney Poitier gives a reason behind the movie's direction:

> According to Poitier, in 1967 the compromised state of the film industry—and by implication, American society generally—required the film to proceed by indirection. Without Kramer's reassuringly tactful handling, this drama of interracial love could not have been produced (Wartenburg 113).

This is an interesting take on the movie: that if it had not been made this way it would not have been made at all. But the question to ask is if it would have been better not to have been made, or to have waited until later when it could have been made stronger without having to rely on the generation gap to avoid the issue of racism in order to gain the film industry's approval.

Guess Who's Coming to Dinner starts as a promising movie about the integration of interracial marriage into the White community, but changes tactics in order to avoid offending the audience that the film industry assumed was still reeling from the Civil Rights Act passed only three years prior to the making of the film. The star-studded cast creates touching moments between the characters, but even though the acting is done very well, the dialogue between the characters is polite and not to the point. The film lacks passion entirely, because even when characters are on the verge of breaking the civility, they are interrupted, either by themselves or a stronger figure. The film ignores the animosity that might have existed between a middle-class Black family and an upper middle-class White family, and focuses on pleasantries instead. Generational issues overshadow the John and Joanna's marriage, and ignore the impact that their marriage could have on American society. The movie hides behind comfortable, long-standing problems in order to avoid confronting what was important to the time period in which it was produced.

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Teaching Multiplication and Division in Fun and Innovative Ways

Erin Volsario (Education)[1]

Phase 1

Public School 38, the George Cromwell School, is a Region 7 school located in the suburban section of Midland Beach on Staten Island. Region 7 is comprised of Staten Island (former District 31) and two parts of Brooklyn (former Districts 20 and 21), and consists of 133 schools (nycenet.edu). Staten Island, a borough of New York City, is the smallest and least populated borough (Encarta.msn.com). The borough has a rich historical background which can be accessed from numerous locales. For example, there is Historic Richmond Town, the Conference House, the Alice Austen House, Snug Harbor and The Jacques Marchais Center for Tibetan Art (Encarta.msn.com). The Staten Island Zoo is often a popular site to visit, as well as the many parks and recreational areas that Staten Island offers (Encarta.msn.com). In the Midland Beach section, there are several businesses that could potentially be beneficial to student learning, such as supermarkets, bagel shops, and restaurants.

Within P.S. 38, the most recent demographics are as follows: 63% White, 28% Hispanic, 5% Black, non-Hispanic, 4% Asian/Pacific Islander, and less than 1% American Indian (greatschools.net). According to greatschools.net, the attendance rate in 2006 was 91%, 64% of the student population was eligible for free or reduced-price lunch, 23% of students had Individualized Education Plans (IEPs), and 6% of students were English Language Learners (ELL) (greatschools.net). On average, the teachers have a total of 15 years experience, and an average of 14 years teaching in the district (greatschools.net). Fourteen percent of the teachers have a Bachelor's degree, and 86% have a Master's degree (greatschools.net). There are numerous programs at the school both before and after school hours. After school programs include Latchkey, Extended Day, Art, and Theater. There is an Early Bird Academy that is used for test preparation. The Parent Teacher Association (PTA) is very active at P.S. 38, and the parent coordinator is heavily involved with the PTA and its activities (greatschools.net). The School Mission Statement of P.S 38 is as follows:

[1] Written under the direction of Dr. Jennifer Lauria (Education)

> The vision of the P.S. 38 Educational Community is to enable the children we serve to achieve he highest level of their intellectual, emotional and social capabilities so that they can become life long learners, problem solvers, and active and productive members in our school and society. The parents, staff and students of our school believe that as a diverse and collaborative school community we are dedicated to achieving high standards of academic excellence for all our students. To this task we commit ourselves to build a school community that works and learns together to create a nurturing, warm, risk free, caring environment that promotes a love for life long learning, for risk taking and inquiry (NYC Public Schools, 2005).

The physical layout of the school consists of the following. After walking in the front door, one will find the main office on the right, where the principal's office is located. To the left is the All-Purpose Room, which functions as a gym and an auditorium. In the right corridor there are classrooms consisting of grades K-2, the library, and Teacher's Lounge. In the left corridor, one will find the lunch room and more classrooms housing grades K-2. The corridor further to the left leads to the annex building, which contains grades 3-5. In the annex, there is also a room where reading recovery and other pull-out services take place, as well as a room for occupational and physical therapies.

In the fifth grade classroom, there are eight tables of 4 students each. Each table is named after a continent, and the students switch tables at the beginning of each month. To the left of the classroom door is the meeting area, consisting of a large rug and a dry-erase board, as well as a chair for the teacher. Along the wall next to the rug, there are baskets where the students store many of their books. Above the baskets there are hooks for the students to hang their coats and bags. There are blackboards on the front and back walls of the room. There are also various centers, including a Writing Center, a Math Center, a Science Center, and a Computer Center.

The Flow of the Day is as follows: Word Study: 8:20-8:40; Math Workshop 8:45-9:30; Science 9:35-10:20; Lunch 10:20-11:10; Read Aloud 11:15-12:00; Independent Reading 12:05-12:50; Writer's Workshop 12:55-1:45; Prep-Gym/Social Studies 1:45-2:30. Extended Day is from 2:40-3:17. There are 32 students in Class 5-40. Four of the students have IEPs, and many of the students have needs that have been informally addressed. One student's mother refuses to let him be tested for any type of disability, but the student clearly has needs that have not been addressed. Some students do not participate in discussions and are quiet and shy. Other students have difficulty remaining quiet and attentive during instructional time. Another student has a medical problem that does not appear to hinder his academic achievement. One group of students

seems to be at risk for academic problems, while another group appears to be at the top of the class. The classroom environment is extremely structured, with very little idle time. This helps to minimize behavior problems, since the students are busy at all times. The environment also fosters independence, responsibility, and respect.

For my teacher work sample, I chose to do a case study. The child I chose to work with is a male student named Vincent who is having difficulty in math, specifically in multiplication and division. Whenever he encounters a multiplication or division problem involving two digits, he becomes very nervous and is unable to think of a strategy to help him solve the problem. My goal is to teach Vincent strategies to help him tackle multiplication and division problems, and to have him practice multiplication and division in fun ways in order to become more comfortable and confident in his math abilities. I will work with Vincent during Extended Day, which is from 2:40 P.M.-3:17 P.M. I will be working with Vincent Monday through Wednesday.

Phase 2

The final objectives for all of the following lessons are to increase Vincent's confidence and strengthen his skills in multiplication and division. The strategies I will use to teach Vincent include drill and practice, flash cards, and games, including a computer game, a division game cube, and multiplication bingo. The assessment strategies include ongoing observation, self-assessment by the student, a pre-assessment worksheet and a post-assessment worksheet and writing piece.

Lesson # 1

Content Area: Math
Grouping Arrangement: One-to-one
Date: 2/26/07
Grade Level: 5
Lesson Concept: Multiplication of Two-Digit Numbers and Division of Three-Digit Numbers; correcting problems

NYS Standards (http://www.emsc.nysed.gov/ciai/):
-Standard 3: **Operations**- Students use mathematical operations and relationships among them to understand mathematics.
Students:

- Add, subtract, multiply, and divide whole numbers

- Develop strategies for selecting the appropriate computational and operational method in problem-solving situations
- Know single digit addition, subtraction, multiplication, and division facts

-Standard 7: Patterns/Functions – Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.

Students:

- Represent and describe mathematical relationships
- Solve for an unknown using manipulative materials
- Use a variety of manipulative materials and technologies to explore patterns

I. Pre-requisite Skills: The student has knowledge of arithmetic operations, including addition, subtraction, basic multiplication, and basic division, and can perform the operations.

II. Goal: The student will perform arithmetic problems with minimal assistance.

III. Objectives:
   1. The student will be able to multiply two-digit numbers without becoming overwhelmed.
   2. The student will be able to divide three digits by two digits without becoming overwhelmed.
   3. The student will be able to apply various strategies in order to perform complex multiplication and division problems independently.

IV. Materials:
   1. Multiplication Worksheet (pre-assessment)
   2. Division problems (from student workbook)
   3. Paper and pencil

V. Procedure:
   1. Administer the pre-assessment multiplication worksheet.
   2. Write the problems that the student performed incorrectly on a piece of paper and have the student self-correct the problems while guiding the student.
   3. Have the student perform additional problems (division) on a piece of paper as time permits with guidance.

Lesson # 2

Content Area: Math

Grouping Arrangement: One-to-one

Date: 2/27/07

Grade Level: 5

Lesson Concept: Multiplication of Two-Digit Numbers and Division of Three-Digit Numbers

NYS Standards (http://www.emsc.nysed.gov/ciai/):

-Standard 3: **Operations**- Students use mathematical operations and relationships among them to understand mathematics.

Students:

- Add, subtract, multiply, and divide whole numbers
- Develop strategies for selecting the appropriate computational and operational method in problem-solving situations
- Know single digit addition, subtraction, multiplication, and division facts

-Standard 7: Patterns/Functions – Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.

Students:

- Represent and describe mathematical relationships
- Solve for an unknown using manipulative materials
- Use a variety of manipulative materials and technologies to explore patterns

I. Pre-requisite Skills: The student has knowledge of arithmetic operations, including addition, subtraction, basic multiplication, and basic division, and can perform the operations.

II. Goal: The student will perform arithmetic problems with minimal assistance.

III. Objectives:
   1. The student will be able to multiply two-digit numbers without becoming overwhelmed.
   2. The student will be able to divide three digits by two digits without becoming overwhelmed.
   3. The student will be able to apply various strategies in order to perform complex multiplication and division problems independently.

IV. Materials:
    1. Multiplication flash cards
    2. Division cube game

V. Procedure
    1. Administer the multiplication flashcards and record data (i.e. how many correct/incorrect).
    2. Play the division cube game.

Lesson # 3

Content Area: Math
Grouping Arrangement: One-to-one
Date: 2/28/07
Grade Level: 5
Lesson Concept: Multiplication of Two-Digit Numbers and Division of Three-Digit Numbers

NYS Standards (http://www.emsc.nysed.gov/ciai/):
-Standard 3: **Operations**- Students use mathematical operations and relationships among them to understand mathematics.
Students:

- Add, subtract, multiply, and divide whole numbers
- Develop strategies for selecting the appropriate computational and operational method in problem-solving situations
- Know single digit addition, subtraction, multiplication, and division facts

-Standard 7: Patterns/Functions – Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.
Students:

- Represent and describe mathematical relationships
- Solve for an unknown using manipulative materials
- Use a variety of manipulative materials and technologies to explore patterns

I. Pre-requisite Skills: The student has knowledge of arithmetic operations, including addition, subtraction, basic multiplication, and basic division, and can perform the operations.

II. Goal: The student will perform arithmetic problems with minimal assistance.

III. Objectives:
    1. The student will be able to multiply two-digit numbers without becoming overwhelmed.
    2. The student will be able to divide three digits by two digits without becoming overwhelmed.
    3. The student will be able to apply various strategies in order to perform complex multiplication and division problems independently.

IV. Materials
    1. Paper and pencil
    2. Task cards
    3. Watch

V. Procedure
    1. Have the student make a multiplication grid consisting of 13 boxes across and 13 boxes down. The first box will be the operation (multiplication: "X") and the boxes will be from numbers 1-12.
    2. Have the student complete the grid and time the student.
    3. Have the student practice division facts using task cards. Separate the answer cards from the question cards and shuffle them. The student takes a question card, solves the problem, and finds the answer card. The student self-checks by turning over the card. If it is correct, the question and the answer cards will match to form a reward (i.e. sticker, praise).

Lesson # 4

Content Area: Math

Grouping Arrangement: One-to-one

Date: 3/6/07

Grade Level: 5

Lesson Concept: Multiplication of Two-Digit Numbers and Division of Three-Digit Numbers

NYS Standards (http://www.emsc.nysed.gov/ciai/):

-Standard 3: **Operations-** Students use mathematical operations and relationships among them to understand mathematics.

Students:

- Add, subtract, multiply, and divide whole numbers
- Develop strategies for selecting the appropriate computational and operational method in problem-solving situations
- Know single digit addition, subtraction, multiplication, and division facts

-Standard 7: Patterns/Functions – Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.

Students:

- Represent and describe mathematical relationships
- Solve for an unknown using manipulative materials
- Use a variety of manipulative materials and technologies to explore patterns

I. Pre-requisite Skills: The student has knowledge of arithmetic operations, including addition, subtraction, basic multiplication, and basic division, and can perform the operations.

II. Goal: The student will perform arithmetic problems with minimal assistance.

III. Objectives:
   1. The student will be able to multiply two-digit numbers without becoming overwhelmed.
   2. The student will be able to divide three digits by two digits without becoming overwhelmed.
   3. The student will be able to apply various strategies in order to perform complex multiplication and division problems independently using technology.

IV. Materials
   1. Computer with Internet access

V. Procedure
   1. Access the website coolmath.com. Click on “Math games,” then “The Timernator!,” then “Division.”
   2. Have the student click on facts 0-12, then “Go.”
   3. Each time the student enters an answer by typing it in the box, he or she must press the “???” button.
   4. Have student do as many problems as time permits.

Lesson # 5

Content Area: Math

Grouping Arrangement: Small group

Date: 3/7/07

Grade Level: 5

Lesson Concept: Multiplication of Two-Digit Numbers

NYS Standards (http://www.emsc.nysed.gov/ciai/):

-Standard 3: **Operations-** Students use mathematical operations and relationships among them to understand mathematics.

Students:

- Add, subtract, multiply, and divide whole numbers
- Develop strategies for selecting the appropriate computational and operational method in problem-solving situations
- Know single digit addition, subtraction, multiplication, and division facts

-Standard 7: Patterns/Functions – Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.

Students:

- Represent and describe mathematical relationships
- Solve for an unknown using manipulative materials
- Use a variety of manipulative materials and technologies to explore patterns

I. Pre-requisite Skills: The student has knowledge of arithmetic operations, including addition, subtraction, basic multiplication, and basic division, and can perform the operations.

II. Goal: The student will perform arithmetic problems with minimal assistance.

III. Objectives:
    1. The student will be able to multiply two-digit numbers without becoming overwhelmed.
    2. The student will be able to apply various strategies in order to perform multiplication problems independently during a game (Multiplication Bingo).

IV. Materials
    1. Multiplication Bingo Game (large orange sheet, small, red cardboard circles for markers, game cards, and game boards)

V. Procedure
    1. Distribute game boards and six markers to each player.
    2. Decide which type of result will win (i.e. corners, top row only, bottom row only, entire board)
    3. Shuffle the game cards (containing answers) and draw one from the deck.
    4. Say the answer out loud, and place the card on the large orange sheet on the place that matches the card.
    5. If a student has the multiplication problem that equals the answer called, he or she places a red marker on that problem. The first to get the result that was decided on in the beginning of the game calls "Bingo" and wins that game.

Phase 3

For the pre-assessment piece, I chose to administer a worksheet of multiplication problems. I saw that Vincent had difficulty multiplying two-digit numbers. I also looked in the Pre-Referral Intervention Manual for ideas on how to help Vincent with his math skills (McCarney, Cummins, and Wunderlich, 2006). During our next session, we went over the problems he completed incorrectly (see Lesson 1). Vincent was able to identify his errors and redo the problems correctly. I asked him directly what he felt he had trouble with, and he stated that division is a problem for him. I picked several division problems for him to do, and guided him through each step. I felt that the best way of assessing Vincent's areas of difficulty was to use his responses in combination with the previous session's worksheet.

I wrote the first few problems on a piece of paper and prompted Vincent by asking him what he would do first. Then, if he made a mistake I first tried to let him figure it out on his own. If he was really stuck, I told him directly and showed him what to do. For the division problems involving two digits, Vincent told me that was where he gets nervous. I told him not to get nervous, just to take it one piece at a time as he does with regular division problems. I instructed him to see if the number can go into the first number underneath the division sign, and if not, I told him to go to the next number. For example, in the problem 315/62, I asked him if 62 can go into 3. It cannot, so then I told him to go to 31, which 62 also cannot go into. I told him, then, that he had to see how

many times 62 could go into 315. I told him to estimate and perform multiplication on scratch paper to get the answer.

I began our next session with multiplication flash cards (see Lesson 2). Vincent did very well with the facts for the smaller numbers (i.e. 1-6). He answered quickly and with confidence as he looked at the card. However, as the numbers became larger (i.e. 7-12), he took longer to produce an answer and looked away from the card. This told me that he needed more practice with multiplication facts for the larger numbers. After we went through the flash cards, I brought Vincent to the hallway to play with a Division Cube. The Division Cube is a blow-up square with division facts printed on it. The cube is thrown back and forth, and wherever the right thumb lands, that is the problem that is said aloud and solved. The same pattern emerged with the division problems as with the multiplication flashcards: Vincent's answers came quickly and confidently for the problems involving smaller numbers, but he took more time to answer the problems that used larger numbers. However, Vincent enjoyed this activity and said that it was fun.

During our next session, I decided to use two strategies to practice multiplication and division (see Lesson 3). First, I told Vincent to make a grid with 13 boxes across and 13 boxes down. In the first box, I had Vincent write a multiplication symbol (x), and in the other boxes, I had him write the numbers 1 through 12. I told him that I was going to time him write his multiplication facts, and then he would do it again and try to beat his own time. This way, he was not competing against another child. Rather, he was competing with himself and seeing how quickly he could remember his multiplication facts. My rationale in doing this activity was that if Vincent masters multiplication, he will find division less difficult. After he finished the grid in 5 minutes and 12 seconds, I gave him the choice to do it again, or to go to another activity and go back to the grid. I felt that giving him a choice would empower him and possibly give a boost to his confidence. The next activity was task cards. I put 14 division problems on index cards, with the questions on one side and the answers on the other. On the back of each card, I wrote encouraging statements (i.e. "Way to go!", "You're so smart!", "Fabulous!", "Great work!", etc.) and designs in colorful markers. I cut each card in half, so that when Vincent figured out the problem and found the answer, he could check his work to make sure that the statement on the back was complete. I made sure to include a range of problems, from easy to difficult. I told Vincent not to get nervous if he came upon a big problem; instead, he should round the numbers and estimate first. For example, when the problem was 7,566/97, I instructed Vincent to first look at the problem as 7,000/90, and figure out how many times 90 could go into 700 by doing the multiplication on scratch paper. Once he figured that out, I told him to use the numbers

from the problem to find the answer. In addition to the encouraging statements on the back of the cards, when Vincent was able to figure out a difficult problem, I gave him verbal praise. Vincent seemed to enjoy working with the task cards, and I feel that they helped reinforce division for him.

Our next session consisted of a technology component (see Lesson 4). I had Vincent go on the website, coolmath.com, and play a game called The Timernator. This game can be played in order to practice addition, subtraction, multiplication, and division facts; however, Vincent played the game only to practice division and multiplication. The first step is for the child to click the multiplication facts that he or she has already learned, and in Vincent's case it was 0-12. The games last for 60-second intervals, and the player has to answer as many as he or she can. The game indicates how many questions the player answers correctly and incorrectly. Vincent performed well during the game. He played 20 division games (see Appendix A), and then asked if he could play multiplication games, of which he played 4 games (see Appendix B). I asked Vincent what he thought of the game, and he replied that he liked it and it was "fun." Vincent needed minimal support to complete the questions. I tried not to interfere a great deal and let him play as best he could. Whenever he got a question wrong, the computer would tell him right away on the screen, and he looked taken aback a bit, and would say things like, "Oh. Oops." Vincent seemed to learn from his mistakes and enjoy the activity overall, and I feel that this was good practice for him.

In our next session, I chose to play Multiplication Bingo (see Lesson 5). I had Vincent play with 5 of his peers. The materials consisted of a large orange sheet with products on it, product cards, game cards, and red cardboard circles that served as markers on the game cards. The game cards had 6 multiplication problems on them. Whichever product card the caller drew from the deck, he or she placed the card on the orange sheet. If the players had a problem that was equal to the product card, they put a marker on that problem. For each game, the players had to try to be the first ones to get a different pattern on their board. Patterns included the middle two rows, the corners, the whole board, the top row only, or the bottom row only. During the first few games, I called the numbers, but then the students took turns being the caller. Vincent performed well throughout the game. He quickly remembered the multiplication facts on his cards, and he was always correct when placing a marker on his game board. Both Vincent and his peers seemed to enjoy the game.

For our next session, I chose to repeat the timed multiplication facts task, as well as the division task cards (see Lesson 3). This time I already had a grid for Vincent to write in the multiplication facts while I timed him. Instead of decreasing, the number of

minutes it took for Vincent to complete the grid increased to 6 minutes and 30 seconds. Vincent seemed disappointed after learning the time it took to complete the grid. However, I reassured him that it was okay, and we proceeded to the next activity. Using the task cards is an activity that Vincent enjoys and one that he said is helpful. As he completed task cards, I guided him through the problems. I told him to remember to round the big numbers to help him come up with a number to multiply the divisor with. Some of the cards were very easy for Vincent, and he said "I don't even need to do work for this one." Those were cards such as 63/9 or 64/8. I feel that mixing those questions with the more difficult ones helps to increase Vincent's confidence in his own math abilities. I asked him if he felt any better with the division. Vincent said that when he gets to dividing 4-digit numbers, he still becomes nervous. I told him not to let those problems freak him out. Instead, I told him to just focus on the first two to see if the divisor can go into those. If not, go to the next number, round, and then multiply. Working in smaller pieces seemed to ease some of Vincent's apprehensions about division.

For our last session, I chose to administer a post-assessment, which consisted of 20 math problems and a written piece. The post-assessment had both multiplication and division problems on it, which Vincent completed with no problem. For the written part, I asked Vincent to write a short paragraph on what he learned and how this time helped him. He said, "In this time I have learned two big things that I needed to learn. I learned how to multiply numbers that are big. I also learned how to divide numbers. I used to not be able to, but now I think I know what I should have from the beginning. I thank Ms. V for the help she has gave me" [sic] (Student-produced response).

Phase 4

According to the data I have collected, there have clearly been improvements in Vincent's multiplication and division skills, as well as an increase in his confidence in his math abilities. The evidence that supports this conclusion includes the difference between the number of errors in the pre-assessment as compared to the post-assessment, the student-produced response, and informal observations. In the pre-assessment worksheet, Vincent made 6 errors on multiplication of one and two-digit numbers. On the post-assessment worksheet, he only made 3 errors, which consisted of one and two digit multiplication as well as one and two digit division problems. In his student-produced response, Vincent expressed that he no longer becomes nervous when he encounters difficult multiplication and division problems. He also articulated the fact that he now can apply the strategies he needs to complete the problems. Throughout our sessions, Vincent appeared to become more confident and less apprehensive. Practice, positive

reinforcement, and encouragement seemed to help Vincent overcome much of his nervousness regarding multiplication and division. Instead of freezing up when he came to a problem, he would think about what strategy he could use, even sometimes stating "I don't even have to do work for this one!" or "This one's easy."

Some of the strengths of the lessons include the fact that the instruction was individually tailored to Vincent's needs, and the activities were fun, interactive, and hands-on. Following the first assessment, I went back and had Vincent correct his own mistakes. I asked him directly what exactly he found difficult about math, and I observed his demeanor while completing more difficult problems to assess whether he was becoming overwhelmed or not. I was able to utilize the information I gleaned to modify instruction and adapt to the student's needs. I also saw that Vincent was more of a visual and tactile learner; he needed to see things and actually do it in order to understand them better. Therefore, I made sure I chose activities that let Vincent become actively engaged and that were visually stimulating as well. For example, the task cards have reward stickers and encouraging words on the back that can be seen as soon as the correct answer card is chosen. In each lesson, I did my best to incorporate activities that were enjoyable to help Vincent see that math is not as scary as he thought. During my informal observations, I noticed Vincent smiling and it appeared he liked the activities. When I asked him what he thought of the activities, he said they were "fun."

There were some weaknesses that I could have improved upon. After a few days, I began to run out of ideas on how to make multiplication and division exciting and fun. Next time I will turn to a colleague and/or a mentor for guidance and additional ideas. If I taught multiplication and division again, I would use more ways to represent them visually. I would also relate it to the real-world more, and show the student how multiplication and division could be used in real-life situations. Word problems would also be helpful in accomplishing this task, which would also tie in another subject area (literacy). I also felt that I could have used more time than just the Extended Day to help Vincent. I could have given him some extra practice to complete at home. My assessment tools could have also been better. Specifically, I could have asked the student to explain his thinking on the page, which would have aided him in sharpening his metacognitive skills.

I found that having high standards for Vincent helped to increase his confidence. I did not repeat the easy questions merely because I knew he could do them. Rather, I gradually gave him harder questions to show him what he was capable of. The activities he liked the best seemed to be the computer game and the task cards. The student-produced response is evidence that Vincent was an active participant in his learning. He

was able to identify what he had difficulty with before and how much he has improved. I am proud of Vincent for the progress he made, and I hope that he continues to utilize the skills he has gained.

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Appendix A

Game Number	Number of Questions Right	Number of Questions Wrong
1	8	1
2	11	1
3	13	0
4	14	0
5	12	0
6	17	0
7	9	1
8	11	0
9	14	1
10	13	1
11	14	1
12	15	1
13	20	0
14	17	0
15	19	1
16	16	1
17	16	2
18	17	0
19	16	0
20	13	0

Appendix B

Game Number	Number of Questions Right	Number of Questions Wrong
1	13	1
2	18	0
3	17	1
4	19	0