Wagner College Forum for Undergraduate Research

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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 two of these sections are limited to papers and abstracts dealing with scientific investigations (experimental, theoretical and empirical). The third section is reserved for speculative papers based on the scholarly review and critical examination of previous works.

As has become a tradition, the fall edition commences with a reprint of the abstracts of papers and posters presented at the Eastern Colleges Science Conference this past spring. The interested reader will then explore the consequences of ice formation on aircraft wings and the use of olfaction by zebrafish to recognize other members of their species. Moving on one encounters an investigation into the importance of imagination and creativity in early childhood education. This is followed by stimulating articles on female comic book heroes and King Creon in the play *Antigone* by Sophocles. Be sure not to miss Traduction ou Réécriture? de *L'Empreinte de l'ange à The Mark of the Angel*, a paper written in French by Caroline Mauduy, an exchange student.

Read on and enjoy!

Gregory J. Falabella, Ph.D.
Editor-in-Chief

Section I: Eastern Colleges Science Conference[1]

Abstracts

[1] Papers and posters presented at the 67th Annual Eastern Colleges Science Conference held in Providence, RI on April 20, 2013.

Section II: The Natural Sciences

Full Length Papers

Section III: The Social Sciences

Full Length Papers

Section IV: Critical Essays

Full Length Papers

Section I: Eastern Colleges Science Conference

Identifying the Onset of Teratogenicity of Lithium Chloride in the Development of Zebrafish (Danio rerio) Eye

Janna Denisenko (Biology), Dr. Ammini Moorthy (Biological Sciences), Dr. Christopher Corbo (Biological Sciences) and Dr. Zoltan Fulop (Biological Sciences)

Lithium chloride (LiCl) is a known teratogen that has been found to cause developmental abnormalities during the formation of eyes in zebrafish and other organisms. LiCl is a frequently used antidepressant in humans. Previous research at Wagner College with higher concentrations of LiCl (0.15M to 0.45M) in zebrafish embryos has resulted in death due to the treatment, blindness, or severe problems during eye development. This paper presents the findings of a double-blind study conducted using lower dosages, where zebrafish embryos were exposed to 0.05M, 0.1M, and 0.15M concentrations of LiCl. Morphological abnormalities were observed under light microscopy following exposure to LiCl to determine the stage of embryonic development where LiCl exerts its teratogenic effects on the eye. The preliminary results demonstrate that treatment with the chemical increases the chances of mortality. Compared with the control, embryos treated with 0.05M and 0.1M had delayed development and displayed atypical lens formation and eye shape. Embryos treated with 0.15M hatched later than expected, had eye deformations and behaved abnormally. In the future, the zebrafish will be processed for basic histological sectioning and whole mount scanning electron microscopy for tissue evaluation.

The Brachistochrone Problem

Vincent Lombardo (Physics) and Dr. Otto Raths (Physical Sciences)

The Brachistochrone Problem, solved by Jean Bernoulli, has been called the most celebrated problem of the 17th century. This study, which represents a continuation of last year's research, presents non-linear approximation using conventional calculus to the Brachistochrone problem.

Finding Antibiotic Producing Microbes in Soil

Juliana Schipani (Microbiology) and Dr. Kathleen Bobbitt (Biological Sciences)

An antibiotic is defined as a chemical substance produced by microorganisms which has the capacity to inhibit the growth of bacteria and even destroy bacteria and other

microorganisms in dilute solution (Smith, 1965). Many of the current antibiotics that are in circulation originate from microorganisms found in the soil. In this research, five soil samples were obtained and tested for microorganisms that produce antibiotics. A serial dilution and streak plate method were used to isolate bacterial colonies. No isolates were found that produce antibiotics against the test organisms, which were *Escherichia coli*, *Staphylococcus epidermidis*, and *Pseudomonas aeruginosa*. It can be concluded that there were no antibiotic-producing microbes in the pure culture that was used to make the serial dilutions. However, that does not mean that there are not antibiotic-producing microbes present in the soil at all.

Development of New Line of Anti-microbial and Possible Anti-tumor Pd–Centered Chemotherapeutics

Sandra Minchala (Chemistry) , Dr. Valeria Stepanova (Physical Sciences) and Dr. Joseph West (Physical Sciences)

Syntheses of target organometallic and inorganic palladium complexes have been performed. A procedure for fast antimicrobial testing based on their in situ syntheses using biologically friendly solvents has been assessed. Correlation of structural features and antimicrobial effectiveness has been discussed. Development of a synthetic procedure to obtain new organometallic N,N-dimethylbenzylamine cyclopalladated complexes with amino acid auxiliaries has been started. Several new Pd-centered compounds have been isolated and characterized using IR, and 1H and 13C NMR spectroscopy.

A Hybrid Computation and Experimental Study of Pd–Based Drug Candidates

Daniel Cimilluca (Microbiology), Dr. Joseph West (Physical Sciences) and Dr. Valeria Stepanova (Physical Sciences)

Molecular geometries of selected palladium complexes have been optimized for water solutions. Gibbs free energies for the first and second aquation have been calculated for several Pd-centered complexes using ab initio DFT/PCM and semi-empirical PM7/COSMO methods. Fair agreement of the parameters obtained by the two methods has been observed. The correlation of calculated properties and known biological activity has been discussed. The development of a calculation-based approach to assess transition

states and the kinetic stability of potential palladotherapeutics has been initiated. Possible pathways for predicting potent biological activity of palladium complexes using DFT/PCM calculations prior to or instead of their syntheses have been proposed.

Growth Rates in Population and Economics

Joseph Biggica (Physics) and Dr. Otto Raths (Physical Sciences)

Growth rates in population and economics are presented and modeled using an elementary differential equation. Both the United States population and debt rate will be used as an example.

Study of Anti-microbial Activity of Palladium Compounds

Lynn Tay (Biology), Dr. Valeria Stepanova (Physical Sciences) and Dr. Christopher Corbo (Biological Sciences)

Antimicrobial activity of cyclopalladated palladium complexes of N,N dimethylbenzylamine bearing different auxiliaries has been tested using Gram(+) and Gram(-) microorganisms. Correlation of the observed antimicrobial activity with a DNA–damage mechanism proposed for the biological response of similar complexes is discussed. Study of the antimicrobial activity has been analyzed using a disk diffusion. The highest activity was observed for the triphenylphosphine cyclopalladated adduct. Pyridine and glycine auxiliaries have shown a reduced effectiveness at similar concentrations. Comparison of antimicrobial effectiveness of organometallic derivatives versus their inorganic coordination analogues was made.

Modification of a Yeast Strain Toward the Creation of a Light-Activated Elongation Factor

Corey Gaylets (Microbiology), Basil Hussain (Microbiology)[1], Dr. Rebecca Zordan (Microbiology)[1] and Dr. Brendan Cormack (Molecular Biology)[1]

Elongation Factor 2 plays a critical role in protein synthesis. During the elongation step of translation Elongation Factor 2 catalyzes the movement of the ribosome downstream the mRNA strand allowing the binding of additional tRNAs and extension of the growing

[1] Johns Hopkins University

polypeptide chain. Through deletion of the Elongation Factor genes on Saccharomyces cerevisiae genome and the introduction of the EFT1 gene into a plasmid vector, a mutagenized copy of EFT1 modified with a transposon containing a LOV (Light, Oxygen, or Voltage) domain will be introduced into the cell creating a light activated Elongation Factor. The strain of Saccharomyces cerevisiae with this protein will be dependent upon light for growth.

Ultrastructural Analysis of Cellular Pathology Induced by Hyperphosphorylated Tau

Holly Santapaga (Biology), Leonid Denisenko (Biology), Dr. Alejandra Del C. Alonso (Biology)[2] and Dr. Christopher Corbo (Biological Sciences)

Tau is a microtubule associated protein (MAP) found in the neurons of the central nervous system. In its non-pathogenic form, tau is predominantly responsible for the stabilization of the microtubule network of the axons. As seen in Alzheimer's disease brain, hyperphosphorylated tau no longer binds to microtubules, but rather self-aggregates into paired helical and straight filaments. This leads to neurodegeneration through two different routes: 1) a lack of microtubule stabilization leads to a destabilization and breakdown of the microtubule network. This causes neurite retraction and leads to compromised axonal transmission since cells can not transport essential components to the axon terminals. 2) The aggregation of tau collects in the cells, sequestering healthy tau and other MAPs leading to cell death. This project aimed to analyze the ultrastructural cellular pathology that occurs after microtubule breakdown in CHO cells expressing a pseudophosphorylated form of tau. In the pseudophosphorylated model, certain serine and threonine residues are switched to glutamic acid, mimicking the negative charge that would be deposited by the phosphate at that site. The results suggest that cells exhibit membrane zeiosis, or excessive membrane blebbing, intracellular granules and the presence of filaments.

[2] CUNY College of Staten Island

Analyzing the Effect of 4-octylphenol on the Development and Viability of Drosophila melanogaster

Pakinam Mekki (Biology) and Dr. Heather Cook (Biological Sciences)

Over the past few decades, there has been an emerging concern about the presence of endocrine disrupting chemicals (EDCs) found in our environment and common household products. EDCs are a diverse group of natural and synthetic compounds, which have been linked to cause a wide range of adverse effects on organisms. In particular, EDCs have the ability to interrupt endogenous hormones by altering the synthesis, secretion, transport or metabolism of a hormone or its ability to bind to specific receptors. In other words, exposure to EDCs can compromise an individual's development and reproduction. EDCs are ubiquitous, and humans are exposed to them on a daily basis. They are found in soil, water, sewage treatment plants, and a variety of man-made consumer products, such as plastic bottles.

The focus of this study is to understand whether 4-octylphenol (4-OP) affects either the viability or the development of the fruit fly, Drosophila melanogaster. 4-OP has been shown to be an endocrine disruptor in mollusks and other aquatic invertebrates. 0-24 hour adult flies were exposed to different concentrations of 4-OP in their food. After ten days of exposure, the number of surviving flies at each concentration was counted. In addition, the effect of 4-OP on the number of pupae formed as well as the number of new flies that eclosed were determined. Our data indicate that 4-OP at concentrations of 0.1nM, 10nM, 1μM, and 1mM do not significantly affect the viability or development of D. melanogaster, when compared to the control. Future studies will analyze the effects of higher concentrations of 4-OP.

The Antimicrobial Activity of Seven Different Plant Extracts on *Streptococcus Mitis*, *Streptococcus Salivarius*, and *Enterococcus Faecalis*

Elaina Tsimbikos (Microbiology) and Dr. Kathleen Bobbitt (Biological Sciences)

Mainstream medicine is increasingly receptive to the use of antimicrobials and other drugs derived from plants, as traditional antibiotics become ineffective and as new, particularly viral, diseases remain intractable to this type of drug. Phytochemicals, or any biologically active compounds naturally found in plants, have been found to have

antimicrobial properties. This research looked at the potential of seven different plant extracts (Tannic Acid, Cinnamic Acid, Capsaicin, Glycyrrhizic Acid, Papain, Weed Pollen, and Phloretin) in inhibiting the growth of Streptococcus salivarius, Streptococcus mitis, and Enterococcus faecalis. These organisms were selected because they can cause infection in humans, especially in the healthcare environment where naturally high levels of antibiotic resistance contribute to pathogenicity. After performing a three-fold dilution for each extract and streaking each dilution onto a nutrient agar plate, the results revealed whether or not the plant extract was a successful antimicrobial agent. The presence of microbial colonies in any one of the dilution sections suggested that the plant extract did not exhibit antimicrobial effectiveness at that particular concentration. Non-numerical observations were made, thus the efficacy of the plant extract was purely based on whether or not the organism grew. In the case of Streptococcus mitis, only 500mg of Tannic Acid prevented the growth of the organism. Capsaicin and Papain prevented the growth of Streptococcus salivarius at concentrations of 250mg and 25mg. Tannic Acid also prevented the growth Streptococcus salivarius, exhibiting antimicrobial effectiveness at all concentrations. Success was seen in inhibiting the growth of Enterococcus faecalis with 500mg of Tannic Acid as well as with 250mg and 25mg of Papain. These results remained constant throughout three trials.

Isolation of *Escherichia Coli* Bacteriophage from Sewage Water

Alisa Ndokaj (Microbiology) and Dr. Kathleen Bobbitt (Biological Sciences)

Escherichia coli (E. coli) is a gram negative, rod shaped bacterium commonly found in the lower intestine of warm-blooded organisms. It is considered to be coliform bacteria, which are commonly used bacterial indicators of sanitary quality of foods and water. Raw, untreated sewage contains large numbers of E. coli. Bacteriophages also referred to as phages, are any of a group of viruses that infect bacteria. The objective of this experiment is to amplify phages in the sewage sample by allowing them to infect and reproduce within fresh E. coli, collect the phages from the culture by centrifugation and filtration, and detect and titer the amplified, isolated phages using a plaque assay. After multiple trials, no phages were found; detecting titer amplification was not possible.

Presence of Methicillin-Resistant Staphylococcus aureus (MRSA) in Wagner College Athletic Facilities[3]

Eden Stark (Microbiology) and Dr. Kathleen Bobbitt (Biological Sciences)

Methicillin-Resistant Staphylococcus aureus has been an increasing problem both in health care settings and now community settings. MRSA continues to mutate and incurs resistance to more antibiotics. In this study samples were taken from Athletic Facilities on Wagner College Campus to identify the community of MRSA, if any, that is present on the Wagner College Campus. Mannitol Salt agar was used to isolate possible MRSA, a catalase test was done, gram stain and disk diffusion susceptibility test were done to try and isolate MRSA. The antibiotics used were Ampicillin (10 μg), Penicillin (10 units), Tetracycline (30 μg), Erythromycin (15 μg), Gentamycin (10 μg), Streptomycin (10 μg), and Vancomycin (30 μg). The three areas of Wagner College Athletic Facilities were the Spiro Sports Center gym, Locker Room, and Walt Hameline Football Field. In the Spiro Sports Center, 56.6% of the 30 plates tested had resistance or intermediate resistance to at least one of the antibiotics tested. In the locker room, 10% of the 30 plates tested, had resistance to at least one of the antibiotics. On the Football Field only 6.7% of the 30 plates tested had resistance to at least one antibiotic. This data indicates that there is a presence of antibiotic resistant S. aureus at Wagner College Athletic Facilities.

Behavioral Effects of Listeria monocytogenes-Induced Blindness in Zebrafish (*Danio rerio*)

Samar Alwani (Biology) and Dr. Brian Palestis (Biological Sciences)

Zebrafish (*Danio rerio)* have proven to be powerful as a research tool in studies of pathology, as well as sensory and behavioral responses such as movement patterns. The gram-positive pathogen *Listeriamonocytogenes* was utilized as an injection into the adult eye of zebrafish. The objective of this research was to examine the behavioral effects of *L. monocytogenes*, which caused blindness in the fish. Thirty-three fish were tested, where twenty-eight were injected with *L. monocytogenes* and fifteen were controls. Every fish was video recorded for ten minutes and measurement of distance between fish was compared between groups of controls and injected fish. The injected fish behaved similarly to control fish, despite their blindness. A t-test was completed demonstrating no

[3] Recipient of Excellence Award

significant difference in the distances between fish among the sighted and blind zebrafish, suggesting an important role of the lateral line in shoaling.

Teratogenic Effects of Stannous Chloride at Various Concentrations on Zebrafish (*Danio rerio*) Embryos[4]

Faiz Abed (Biology), Dr. Ammini Moorthy (Biological Sciences) and Dr. Christopher Corbo (Biological Sciences)

Stannous chloride (SnCl2), commonly found associated with packaged food, soft drinks, tooth paste etc. is shown to have teratogenic effects in humans. The current investigation is to assess the teratogenic effects of stannous chloride in zebrafish (Danio rerio). Zebrafish embryos reared in a laboratory setting were exposed to different concentrations (0.25, 0.35 and 0.50 micro molars) of stannous chloride for 10 minutes during embryogenesis and compared with the embryos of the control group. The experiment was set up as a blind study. Morphological features of the embryos were followed for 10 days after treatment, using light microscopy. Some of the embryos died and tally of the dead embryos were kept from all four groups for the duration of the experiment. Later, the embryos were fixed, sectioned and stained for histological observations and whole embryos were prepared for observations under scanning electron microscope. Preliminary results from this study indicate that stannous chloride causes morphological malformations in the hearts, heads and the spinal cords of the treated embryos, confirming the fact that stannous chloride is indeed a teratogen. Histological observations of cut sections from the embryos and scanning microscopy work are in progress. Our study also shows that the treatment with stannous chloride increases the mortality rate in the embryos.

[4] Recipient of Excellence Award

Section II:
The Natural Sciences

Aircraft Icing and its Effects on Lift

Carley Nicoletti (Physics and Mathematics), Leobardo Dominguez (Physics and Mathematics), and Michelle Greenough (Chemistry)[1]

A Flotek 1440 Low Speed Wind Tunnel housed in the basement of the Megerle Science Building was utilized in this research endeavor. Data from the pressure taps on a NACA-2415 airfoil provided the information necessary to compute the coefficients of pressure and lift. This data was taken at various angles of attack, all at a tunnel velocity of 25 m/s yielding a Reynolds number of 2.5×10^5. A glaze ice horn was then created and placed on the leading edge of the airfoil. New measurements were taken when this ice form was in place and the data processed to again reveal the C_L and C_P. With this information, conclusions were drawn about the effects of the ice being present on the airfoil. It was observed that when glaze ice is present on the leading edge of an aircraft wing the aerodynamic performance of the aircraft is severely compromised. Aircraft accidents can result if this ice accumulates in-flight or if the proper precautions are not taken before take-off.

I. Introduction

Ice that accumulates on an aircraft can be detrimental to its performance and becomes a major threat to flight safety. This occurs when the plane is not properly deiced before takeoff or the aircraft experiences a loss of control during flight from the ice accumulation. In 2002 the FAA noted that ice accumulation on an aircraft wing lead to 30 deaths, 14 injuries and 96 million dollars in damages per year in the United States alone[1]. As a result, it has become imperative to understand how such ice accretions alter the aerodynamics of the aircraft so that systems can be put into place to detect these conditions and prevent future incidents.

There have been numerous major in-flight accidents that have resulted from ice accumulation on the aircraft. Five have occurred recently, which has prompted the United States to take a serious look at the systems set in place to detect ice formation. On February 12, 2009, an aircraft that was on its way to Buffalo, NY impacted the ground five miles northeast of the airport. Unfortunately, the deicing system in place did not

[1] Research performed under the direction of Dr. Gregory Falabella.

inform the pilots that conditions warranted its activation. The ice continued to accumulate in-flight and eventually resulted in stall causing the accident[2]. The second mishap occurred in Roselawn, Indiana where a twin-engine ATR–72-212 rolled roughly 70 degrees right wing down and then proceeded to a rapid fall until crashing into the ground. This incident was due to ice forming past the de-ice boots when the plane was in a holding pattern which caused a loss of control[2]. Also, on January 9, 1997 a 120RT twin-engine hit the ground during landing when thin rough glaze ice was forming along the leading edge of the deicing boot surfaces in Monroe, Michigan. The plane was unable to complete landing since the ice accumulation was too great and adequate minimum airspeed was not maintained[2]. Five years prior, on March 22, 1992 an aircraft was deiced twice before take off in Flushing, New York. These procedures proved to be pointless when after the second deicing the aircraft waited 35-minutes before leaving the runway. This holding period exceeded the 11-minute period where it is safe to take off without deicing again[2]. Similarly in Denver, Colorado an aircraft was deiced and then experienced a 27-minute waiting period where new ice was able to accumulate before takeoff resulting in an accident[2]. Even though these last two accidents resulted from human error, it is important to remember that during takeoff and landing is when ice accretion can be the most devastating.

When combining all five fatal accidents, a total of 202 lives were lost and 78 people were injured[2]. It is therefore essential to understand the impact that ice formations have on stability and lift.

Ice can form on an aircraft through various weather conditions such as rain or snow. In fact, Steven D. Green of Flight Operations Research in Underhill, Vermont noted that freezing rain and snow contributed towards 33% and 32% of all inflight icing accidents from 1978 to 2005[2]. Icing conditions become severe when the ice forms from supercooled large droplets (SLD). The danger that an aircraft is in once it comes into contact with SLD is far worse when put in comparison to an aircraft that comes into contact with freezing rain. This is due to the fact that SLD is caused because the droplets freeze at any location of the wing when in flight. SLD becomes even more of an issue since they form anywhere in a cloud so they become difficult to detect[1]. This detection difficulty adds to the preexisting issue with the icing prevention systems in place since detection is a large contributing factor to the icing accumulation problem.

When ice forms on an aircraft, different shapes can be created. The two most common types of ice accretions are rime ice and glaze ice. These ice shapes form depending on the temperature of the water droplets and the surrounding air temperatures.

Rime ice forms at colder temperatures while glaze ice forms at warmer temperatures, specifically temperatures just below freezing[3]. Rime ice freezes on impact to the airfoil so it tends to create a streamline shape[4]. Glaze ice can create serious issues when discussing the aerodynamic performance of the aircraft because this type of ice accretion forms with horn-like characteristics. The glaze ice horns form due to the water droplets flowing back on the surface before freezing[5]. Certain glaze ice horns can lead to a decrease in lift, which could result in severe safety issues.

This decrease is the result of a pressure distribution that is radically altered by the presence of a separation bubble just behind the ice on the upper surface. At low angles of attack this recirculation region extends a great deal further downstream the wing. As the angle of attack increases the bubble will periodically shed or burst. The result is a significant reduction in the maximum coefficient of lift as well as premature stall[5].

II. Theory and Methodology

Before it was possible to collect data from the wind tunnel and investigate the issues that ice accretions create, it was necessary to understand how we could use the wind tunnel to collect specific data to help us solve for the forces acting on the wing's surface.

Figure 1: The Flotek 1440 Wind Tunnel.

The Flotek 1440 Wind Tunnel shown in figure 1 was utilized for all data collection. After becoming acclimated with its operation, procedures for processing the information collected from the pressure taps were explored. Specifically, we converted the readings from centimeters of water to Pascals, the standard SI unit (1cm H_2O = 98.06 Pa). Then we determined the location of the pressure taps. After this was completed, a dimensionless parameter known as the coefficient of pressure was calculated. The coefficient of pressure (equation 1) is the difference between the surface pressure at a given location and the free stream pressure normalized such that a single curve can be used for different velocities.

$$C_p = \frac{P - P_\infty}{\frac{1}{2}\rho_\infty v_\infty^2} \tag{1}$$

In the above equation, p is the pressure at the point being examined, p_∞ is the ambient or freestream pressure, ρ_∞ is the ambient density and V_∞ is the freestream velocity. The coefficient of pressure is a unitless dimension.

Next, aerodynamic lift (equation 2) was addressed. Lift is the component of forces acting on an airfoil that opposes gravity producing a net upward force. This is made possible for an aircraft because it is designed so that the pressure of the air above the wing is much less than the pressure below the wing. As a result, the aircraft is able to leave the ground.

$$L = -\int p \sin\theta \, dA \tag{2}$$

This result is commonly presented as another dimensionless parameter, C_L, the coefficient of lift where S is the platform area (i.e. the area that one would see if looked at from above).

$$C_L = \frac{L}{\frac{1}{2}\rho_\infty v_\infty^2 S} \tag{3}$$

For an experimental setup there are a finite number of pressure taps so the integral in equation (3) must be replaced by a summation.

$$C_L = \sum \frac{P_{abs} \, \Delta A \sin\theta}{\frac{1}{2}\rho_\infty v_\infty^2 S} \tag{4}$$

In this investigation the locations used are the trailing edges, the leading edge and the midpoints between the taps. Summation is carried out from the trailing edge of the lower surface around the wing to the leading edge and then to the trailing edge of the upper surface to maximize accuracy. The area between pressure taps, the actual pressures themselves and the angle between the airflow and the normal of the line created between midpoints of the taps were computed by using an Excel spreadsheet (table 1 and 2). The interval between pressure taps was treated as a straight line making the computation of the length and normal straightforward (Figure 2).

Surface Pressure			**Bottom**	**C_P**	**C_P AVG**
Upper	Cm of H_2O	Pascals	Trailing		
Tap 1	-3.34	-327.53		0.0032	0.0032
Tap 2	-6.06	-594.27		-0.0534	-0.0251
Tap 3	-6.64	-651.14		-0.1102	-0.0818
Tap 4	-6.43	-630.55		-0.1629	-0.1365
Tap 5	-5.99	-587.40		-.30000	-0.2315
Tap 6	-5.5	-539.35		-0.3317	-0.3159
Tap 7	-4.7	-460.90		-0.3422	-0.3369
Tap 8	-4.13	-405.00	Leading	0.1034	-0.1194
					0.1113
			Upper		0.1193
Lower	Cm of H_2O	Pascals	Leading		-0.2394
Tap 1	-3.40	-333.42		0.11925	-0.6745
Tap 2	-5.09	-499.14		-0.5980	-0.7233
Tap 3	-5.05	-495.22		-0.7510	-0.6376
Tap 4	-4.93	-483.45		-0.6956	-0.5149
Tap 5	-4.41	-432.46		-0.5795	-0.3449
Tap 6	-4.21	-412.85		-0.4503	-0.1642
Tap 7	-3.995	-391.76		-0.2393	-0.0891
Tap 8	-3.78	-370.68	Trailing	-0.0891	

Table 1: Conversion of pressure tap readings to coefficients of pressure (AOA 2^0, Re=$2.5x10^5$).

C_P	x/c	x/c	x/c 1	y/c 1	x/c2	y/c 2	A	Theta	CL
0.0032	1.0000	0.8266	1.0000	0.0000	0.8266	-0.0183	0.174	-1.466	47.06048
-0.0251	0.8266	0.6560	0.8266	-0.0183	0.6560	-0.0342	0.171	-1.478	46.29964
-0.0818	0.6560	0.5148	0.6560	-0.0342	0.5148	-0.0455	0.142	-1.491	38.30998
-0.1365	0.5148	0.3628	0.5148	-0.0455	0.3628	-0.0542	0.152	-1.514	41.23158
-0.2315	0.3628	0.2265	0.3628	-0.0542	0.2265	-0.0570	0.136	-1.550	36.96125
-0.3159	0.2265	0.1490	0.2265	-0.0570	0.1490	-0.0541	0.078	1.534	21.00871
-0.3369	0.1490	0.0713	0.1490	-0.0541	0.0713	-0.0439	0.078	1.440	15.216338
-0.1194	0.0713	0.0152	0.0713	-0.0439	0.0152	-0.0226	0.060	1.208	4.12805
-0.1113	0.0152	0.0000	0.0152	-0.0226	0.0000	0.0000	0.027	0.591	-3.41299
0.1193	0.0000	0.0126	0.0000	0.0000	0.0126	0.0272	0.030	-0.434	-13.36728
-0.2394	0.0126	0.0619	0.0126	0.0272	0.0619	0.0558	0.057	-1.046	-26.23254
-0.6745	0.0619	0.1588	0.0619	0.5580	0.1588	0.0812	0.100	-1.314	-29.50431
-0.7233	0.1588	0.2678	0.1588	0.0812	0.2678	0.0926	0.110	-1.466	-39.85743
-06376	0.2678	0.4150	0.2678	0.0926	0.4150	0.0917	0.147	1.565	-41.17547
-0.5149	0.4150	0.5670	0.4150	0.0917	0.5670	0.0787	0.153	1.485	-39.92730
-0.3449	0.5670	0.7143	0.5670	0.0787	0.7143	0.0584	0.149	1.433	-43.45099
-0.1642	0.7143	0.8745	0.7143	0.0584	0.8745	0.0288	0.163	1.388	-34.05079
-0.0891	0.8745	0.0288	0.8745	0.0288	1.0000	0.0000	0.129	1.345	**0.291648**

Table 2: Computation of the coefficient of lift.

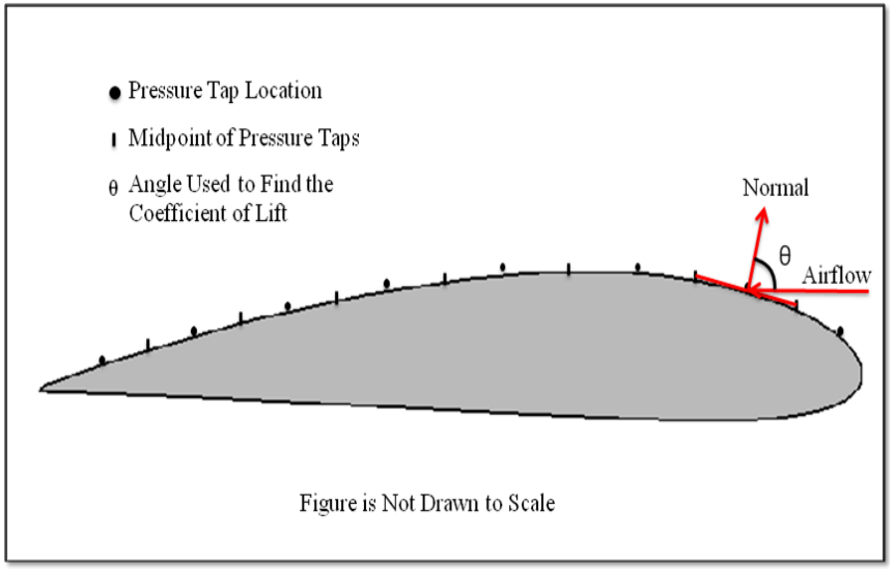

Figure 2: Parameters used to obtain the coefficient of lift.

Armed with a procedure that produced physically sound results for the test case we proceeded to analyze the clean wing at angles of attack, AOA, ranging from -4° to 16° at a Reynolds number of 250,000. This was accomplished with a tunnel velocity of 25m/s which is close to the maximum that can be achieved with our equipment.

The Reynolds number is the ratio of inertia to viscous forces.

$$Re_L = \frac{\rho L v}{\mu} \tag{5}$$

In equation (5) ρ is the density of the fluid, μ is the viscosity of the fluid, L is the chord length and ν is the tunnel velocity. The transition from laminar to turbulent flow occurs at a Reynolds number of 500,000. Hence all of our measurements occurred in the laminar regime.

Lastly the most crucial step, the design and testing of a simulated ice accretion shape, was undertaken. Interestingly, it is the shape and not the weight of the ice accumulation that often contributes to catastrophic results. A glaze ice shape was chosen because it significantly alters the aerodynamics and is most dangerous to an aircraft in flight.

The glaze ice accretion was shaped out of Styrofoam and can be seen in Figure 3. Styrofoam was chosen due to its ability to be shaped easily and the roughness that the surface offers. This shape includes the classic ice horn that occurs at near freezing temperatures. The ice piece was attached to the airfoil using rubber bands.
The ice form covered three pressure taps so it was necessary to poke holes through the Styrofoam where those taps were located. This exposed the pressure taps so that they would be able to make readings. To confirm that nothing was blocking these two upper and one lower pressure taps a test run was conducted. Once the ice piece was in the proper location on the airfoil and all of the pressure taps were reading properly, we were able to make the measurements regarding how the pressure distribution is affected by the accumulation of ice at the leading edge. The ice somewhat retarded the performance of the tunnel so a Reynolds number of 200,000 was used. This was also in the laminar regime so the results are consistent with those taken for the clean wing, the effects of the addition of the ice where immediately apparent implying that there would be a significant variation with the coefficient of lift.

Figure 3: The glaze ice shape is attached to the leading edge of the wind tunnel.

III. Results

The procedure described in the previous section used to find the coefficient of lift was replicated at angles ranging from -4 to 16 degrees when ice was absent from the airfoil and when a simulated ice piece was present on the airfoil. The tunnel velocity was at a speed of 25 m/s when ice was absent from the airfoil and a velocity of 20 m/s when the ice piece was positioned on the airfoil yielding Reynolds number's of 2.5×10^5 and 2.0×10^5 respectively. As anticipated the presence of the ice resulted in a decrease in lift and premature stall[6]. However, the extent to which the relatively small accretion altered the flow field was surprising.

Figure 4 shows the coefficient of lift versus angle of attack. For a clean wing, the general shape remains consistent. As the angle of attack increases there is almost a linear increase in the coefficient of lift. This increase will reach a maximum point and then sharply decrease. The point where the lift coefficient hits its maximum and begins to drop is known as stall. As the top curve indicates, a clean NACA-2415 section stalls at an angle of approximately 15^0 degrees and can attain a maximum lift coefficient of lift 1.22.

The bottom curve resulted when simulated glaze ice was added. Note that the linear portion seen on the clean airfoil is absent. Furthermore, increases in lift occur more gradually never exceeding C_L=0.25, a dramatic reduction of 80% compared to that associated with the clean wing. Stall takes place earlier at 11^0.

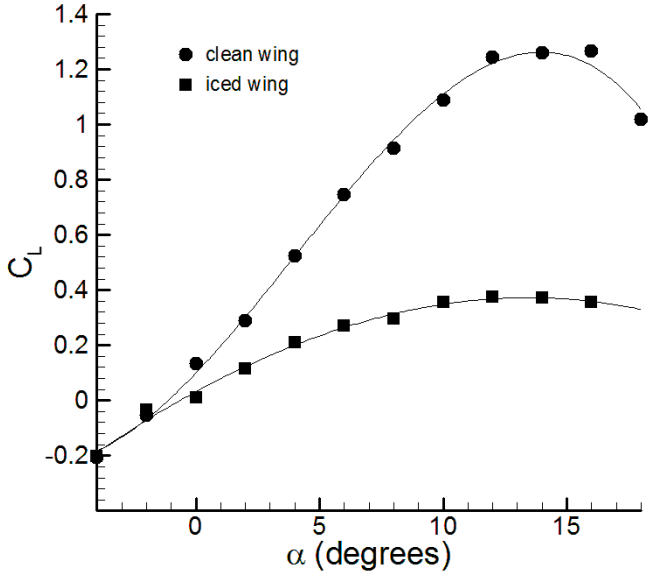

Figure 4: Lift as a function of angle of attack for both the clean and iced wings.

Figures 5-15 show the coefficients of pressure changes as you go from the leading edge to the trailing edge of the wing. Present in every case is a recirculation region behind the icing horn which dramatically flattens the suction peak[6]. This in turn prevents the flow of air over the wing from attaining substantial increases in velocity and the decreases in pressure necessary to produce an adequate upward lift force.

At negative angles of attack (figures 5-6), the clean upper surface has a higher coefficient of pressure beginning at the leading edge. As you move further along the airfoil towards the trailing edge, the clean upper surface coefficient of pressure decreases and the lower surface's coefficient of pressure becomes greater. When ice is present on the airfoil the lower surface C_P has a gradual decrease and then moves toward the upper surface coefficients of pressure.

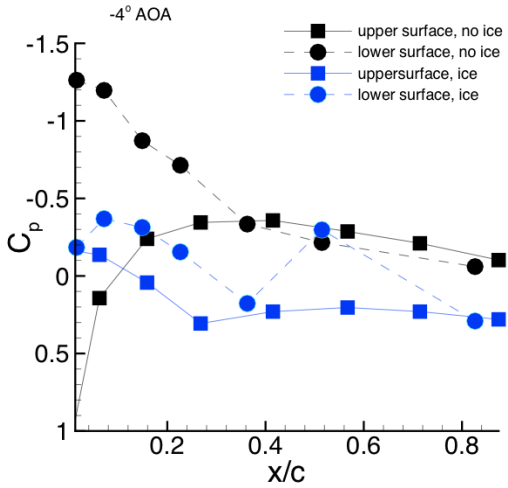

Figure 5: Coefficient of pressure at -4^0 AOA

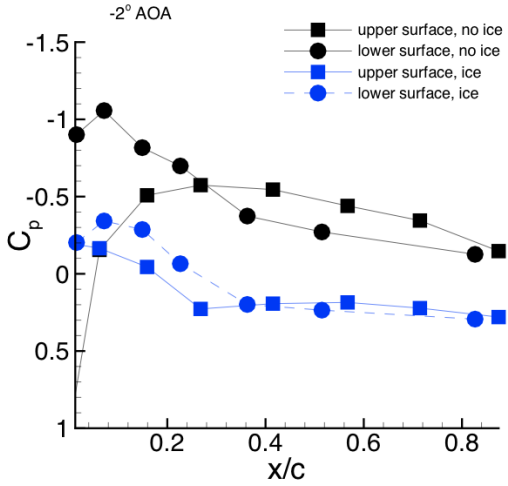

Figure 6: Coefficient of pressure at -2^0 AOA

At the angles of attack near zero (figures 7-9), the leading edge becomes a stagnation point with pressure decreasing as the air accelerates around the surface. The presence of the ice inhibits this curtailing the pressure drop.

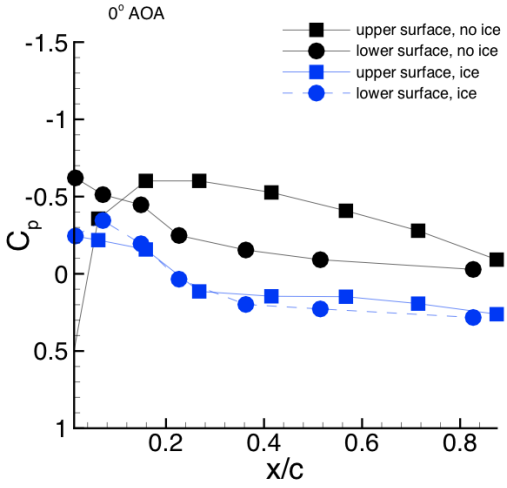

Figure 7: Coefficient of pressure at 0^0 AOA

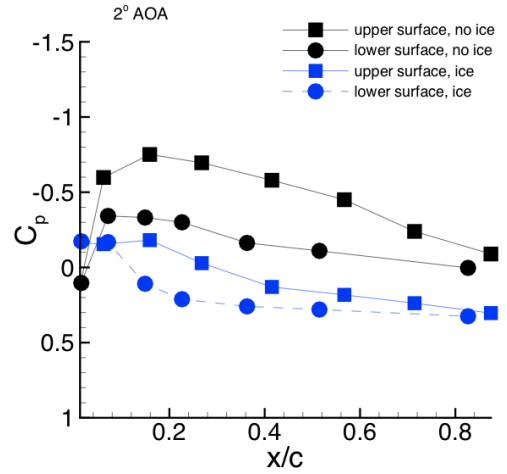

Figure 8: Coefficient of pressure at 2^0 AOA

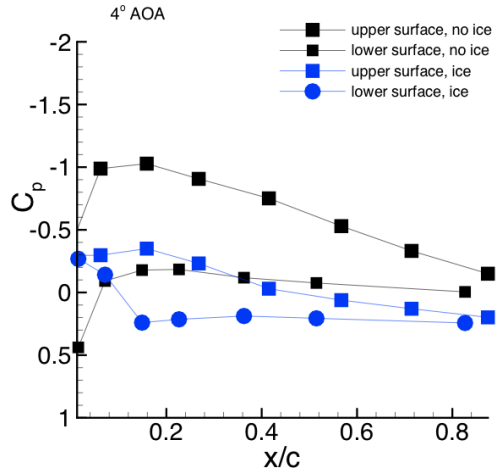

Figure 9: Coefficient of pressure at 4^0 AOA

At larger angles of attack there is a substantial difference between the coefficients of pressure of the lower and upper surface near the leading edge when no ice is present. The much lower pressure on top translates into a sizable upward force. The ice serves to negate most of the differential resulting in a failure to achieve adequate maximum lift. The separated flow associated with the recirculating bubble is responsible for this.

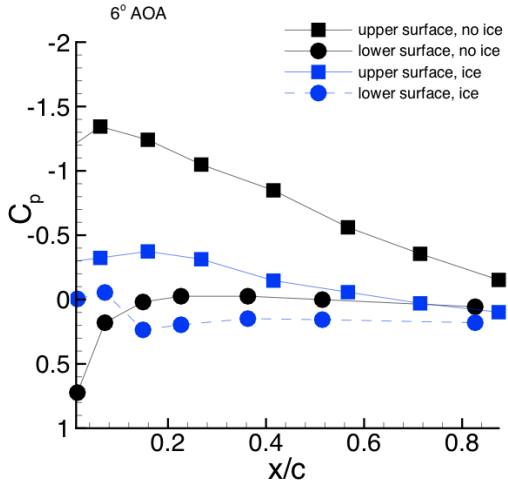

Figure 10: Coefficient of pressure at 6^0 AOA

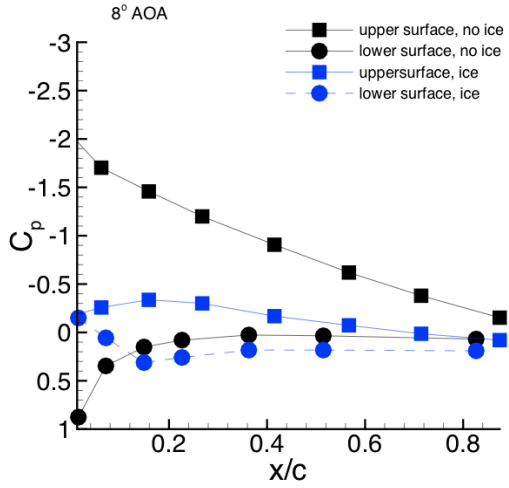

Figure 11: Coefficient of pressure at 8^0 AOA

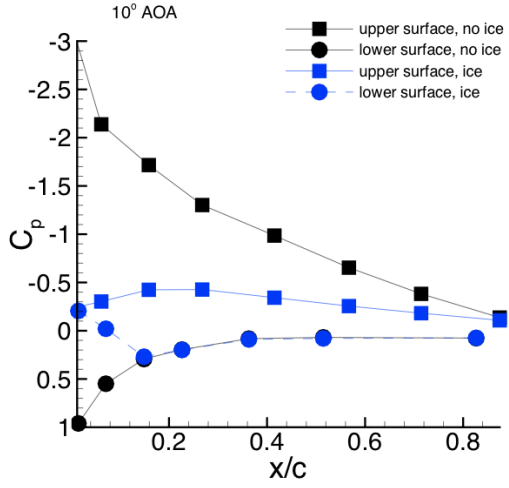

Figure 12: Coefficient of pressure at 10^0 AOA

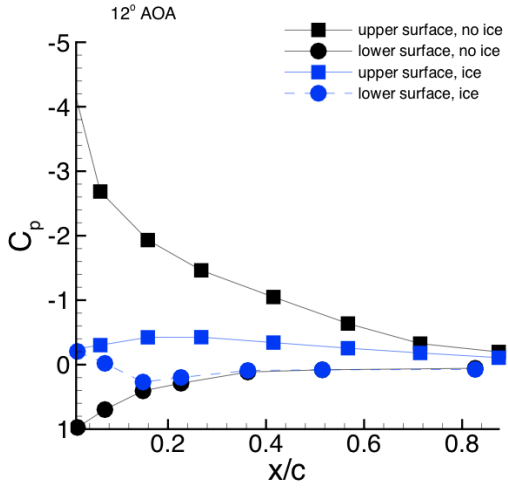

Figure 13: Coefficient of pressure at 12^0 AOA

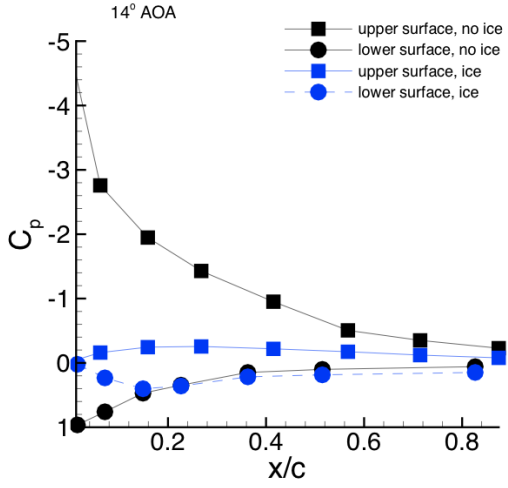

Figure 14: Coefficient of pressure at 14^0 AOA

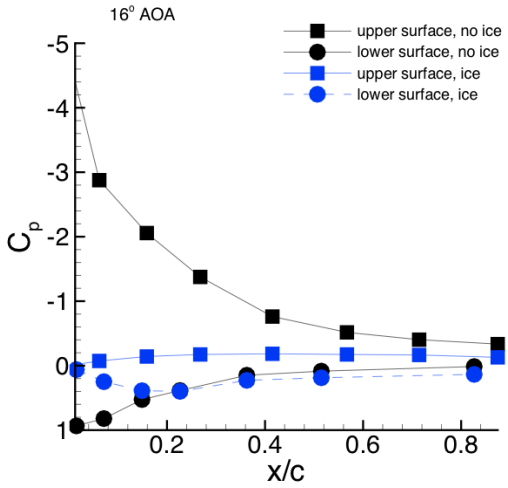

Figure 15: Coefficient of pressure at 16^0 AOA

IV. Conclusion

Effects on flight due to ice formation on an aircraft's wing have been studied since the early 1900's. Even though the ice accretions are small in comparison to the size of the wing, its presence on an aircraft can become dangerous. This experiment allowed us to examine the surface pressure distribution on a NACA-2415 wing section and changes in the coefficient of lift at various angles of attack. Comparisons between the clean wing and one with a Styrofoam simulated ice form attached to it were made.

From the results it was evident that substantial aerodynamic losses could result from a relatively small ice accretion shape. This poses a problem for aircraft subjected to in-flight icing. More research needs to be done with regard to designing deicing systems that inhibit the formation of certain detrimental shapes. In addition, detection systems must be improved and flight crew prepared on how to read and react should a problem arise.

V. Acknowledgements

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academic institution. Finally, we would like to extend a special thanks to all of our families for the support that they have offered us during our entire research experience.

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Species Recognition in Zebrafish (*Danio rerio*) Based on Olfactory Cues

Adam Rizzuti (Biology)[1]

The use of chemical stimuli has been observed to be an advantageous adaptation important in various roles in many different species. One of these roles is the recognition of individuals of the same species via olfaction. In this study, zebrafish (*Danio rerio)* behavior was tested, observed, and analyzed to determine their ability to differentiate conspecifics from the purple passion danio (*Danio roseus*). A zebrafish was placed into a tank, as well as two opaque cups that had pin holes punched into them. In one of these cups was a male and female zebrafish and in the other was a male and female purple passion danio. The holes that were punched into the cups allowed any chemical stimuli secreted from the fishes to diffuse into the water. These cups were placed at opposite ends of the tank, and over a 10-minute period, the position of the test zebrafish was observed and recorded. It was theorized that if the test zebrafish spent significantly more time near the cup that contained zebrafish then it had recognized and differentiated their presence from the purple passion danio due to olfactory cues. Results were analyzed using the Wilcoxon signed-rank test. It was determined that the test zebrafish did not spend significantly more time on either end of the fish tank containing the zebrafish and purple passion danio. Possible explanations for this are discussed. Comparatively, in the control experiment in which one cup contained male and female zebrafish and the other was left empty the test zebrafish spent significantly more time near its conspecifics. The results of this control test illustrate that the zebrafish could identify conspecifics via olfaction and preferred to spend a significant amount of time near them.

I. Introduction

General Information on the Various Roles and Importance of Chemoreception

Chemical substances play important roles in a wide range of aspects in the everyday lives of many organisms. These molecules affect inter- and intraspecific

[1] Research performed under the direction of Dr. Brian Palestis in partial fulfillment of the Senior Program requirements.

relationships, as well as orientation and migration of animals (Kleerekoper 1969). The various roles of chemical substances include the recognition of prey and predator, identification of males and females within a species, individuals of the same or other groups, home territory, and nesting and spawning sites (Kleerekoper 1969). The ability for an animal to differentiate between all of these things is often dependent on their perception and identification of specific chemical substances (Kleerekoper 1969).

Specialized chemoreceptors have evolved that can detect and respond to chemical substances with varying degrees of intensity (Kleerekoper 1969). When these receptors are excited by a chemical cue, an electrical signal is propagated and sent to the central nervous system (CNS). When the message reaches the CNS, it is interpreted and can be responded to in a variety of ways. For example, a specific chemical compound may be identified as belonging to a predator which may cause a fleeing response.

The ability to perceive chemosensory information confers an enormous advantage for certain organisms (Wyatt 2003). It has been observed that these sensory signals are often produced by individuals to convey vital information to other members of the same species (Wyatt 2003). For example, fish have been observed to release pheromones into surrounding waters to stimulate behaviors such as reproduction, shoaling, recognition, and alarm signaling (Wyatt 2003). The release of these chemical signals requires little energy expenditure, so it is an extremely efficient way of conveying information (Wyatt 2003). An additional advantage of this practice is that chemical stimuli can be used to convey information when sight is limited in cases of decreased visibility (Wyatt 2003).

The significance of chemical signals in the acquisition of food has been illustrated many times. One of the earliest experiments was done in 1890 (Kleerekoper 1969). When a number of aquatic species were placed in a tank and exposed to the odors of food, the individuals with intact olfactory organs were able to find food much more easily than the test animals that had their olfactory organs destroyed (Kleerekoper 1969). The organisms that relied on their olfactory sense to acquire food were not affected by the researchers' attempts to hide the food from sight, further showing that the sense of smell plays an important role in food acquisition (Kleerekoper 1969).

In many species chemical stimuli plays an important role in reproduction. During breeding season the male peacock blenny (*Blennius pavo)* secretes a substance from its vent region into holes and cracks in the rocks of its marine environment (Kleerekoper 1969). It has been observed that multiple females may respond to the odor produced by this substance by depositing their eggs into the nest of a single male

(Kleerekoper 1969). A similar type of chemical substance has also been identified in lampreys. When male lampreys secrete the substance from their bodies female lampreys are observed to be attracted to the odor (Kleerekoper 1969).

Olfaction has also been extensively linked to the migratory behavior seen in many animals. Specifically, it has been discovered that olfaction is the primary sensory system that guides the Pacific salmon (*Oncorhynchus* spp.) from the ocean back to the stream in which it hatched, to spawn (Carruth *et al.* 2002). This migration back to their home stream, called upstream migration, is guided by the salmon's olfactory system and their remarkable ability to differentiate between the chemical compositions of different streams. According to Carruth *et al.* (2002), young salmon undergo many physiological, morphological, and behavioral changes that prepare them for their journey to the ocean and for their journey back to their home stream. During this process, called smoltification, the unique chemical composition of the home-stream is imprinted onto salmon. This event is paramount for salmon to successfully return to their natal streams for spawning. When the salmon imprint the chemical composition of the natal stream they are actually imprinting on the individual combinations of the odorants found in varying concentrations in the stream water. Hara (1992) has determined that there are four major aquatic odorants fish recognize. These odorants are amino acids, bile salts, steroid hormones, and prostaglandins (Hara 1992). Salmon are extremely sensitive to these odorants, thus they can detect them even at very small concentrations. Ueda *et al.* (1967) demonstrated through electrophysiological recordings that Pacific salmon can distinguish the waters of their natal stream on which they are imprinted from either natural water samples or synthetic chemicals. This amazing application of imprinting helps illustrate the importance of olfaction in the survival and propagation of the species that utilize it.

The olfactory sense influences a wide range of behaviors, depending on the organism being studied. The wide range of chemical stimuli that interact with this sensory system may be interpreted as sexual signals, alarming signals, species recognition signals, migration signals, or signals that indicate the presence of food or danger. The study of chemical stimuli, the signals they produce in an organism and the olfactory channel of communication can provide a gateway into why and how certain behaviors exist in a multitude of organisms.

General Background on Zebrafish

The zebrafish (*Danio rerio*) is a small, freshwater teleost that has been established as a powerful research model for many areas of biology and medicine (Beliaeva *et al.* 2010). The zebrafish is both convenient and cost effective to work with from a technical and methodological point of view (Segner 2009). Some of the technical advantages of the zebrafish include ease and cost of maintenance, high fecundity, rapid development, ease of observation and manipulation, availability of genetic information, existence of mutant strains, and cooperativeness with both forward and reverse genetics (Segner 2009). According to Segner (2009), this species has provided insights into many aspects of vertebrate biology, genetics, toxicology, and disease, because its traits can be generalized. The generalization of the zebrafish's traits allows it to be representative of a larger group of organisms. The zebrafish has been used as a model for a variety of human diseases including cancer, movement, and sleep disorders among other conditions (Buske & Gerlai 2011).

One of the most remarkable characteristics of the zebrafish is that it develops externally without an eggshell, causing the egg to be optically transparent (Fang 2012). This allows scientists to easily observe the changing phenotype of the developing zebrafish embryo. Additionally, these characteristics allow scientists to test the effects of various drugs, toxins, and other chemicals by simply adding them to the water in which the zebrafish is developing (Segner 2009). Due to these traits, many toxicological studies use zebrafish embryos and larvae for initial characterization of environmental hazards or therapeutic candidates, before advancing to larger animal models (Fang 2012).

The zebrafish is a shoaling fish, meaning that individuals aggregate to form multimember groups in nature and in the laboratory (Buske & Gerlai 2011). Shoaling is thought to provide individual fish with multiple benefits, including access to mates, efficient foraging, and defense against predators (Buske & Gerlai 2011). According to Buske and Gerlai (2011), the study of the biological mechanisms and development of this social behavior can help us understand the mechanisms that cause the psychiatric and neurodevelopmental conditions in humans that are characterized by abnormal social behavior. These conditions include depression, anxiety disorders, and the autism spectrum disorders (Burke & Gerlai 2011). The zebrafish is thought to be a suitable model for investigating the biology and genetics of vertebrate brain functions because of the many similarities zebrafish and other vertebrates, including humans, share. These similar characteristics include the layout of the brain, the neurochemical properties of the

brain, and many other levels of biological organization, including nucleotide sequence of genes (Buske & Gerlai 2011).

Olfaction in zebrafish has been observed to be important in the development of shoaling and other behaviors (Gerlach *et al.* 2007). According to Gerlach *et al.* (2007), zebrafish prefer the olfactory cues of kin to non-kin. The study of this preference revealed an imprinting-like effect of olfactory cues at an early age of the fish (6 days post fertilization) and suggested that some preference for conspecifics already exists at this stage of development (Gerlach *et al.* (2007). It is likely that this preference for conspecifics via chemical stimuli plays an important role in shoaling behavior.

Olfaction Sense in Zebrafish

In order to survive in an ecosystem, animals must be able to perceive and respond to the information in their environment. The ability to interpret this information depends on the presence of sensory organs, their sensitivity, their ability to determine the origin of stimuli, and to induce behavioral events which must be both adequate and low cost in terms of energy (Faucher *et al.* 2012). Olfaction is one of many senses that confer the ability to interpret and respond to information in the environment.

Multiple studies have illustrated the importance of olfaction in zebrafish. This sense plays a major role in many aspects of the everyday survival of individual zebrafish. It has been determined that zebrafish use olfactory cues and visual cues to choose mates and regulate reproduction (Gerlach *et al*. 2007). In addition, olfactory cues have been observed to be critical for triggering and synchronizing mating behavior, as well as stimulating or surpressing reproducing in females (Gerlach *et al.* 2007). According to Gerlach *et al.* (2007), olfactory cues allow zebrafish to distinguish reproductive stage, relative dominance, and degree of relatedness among conspecifics. Based on the study of olfaction in zebrafish it has also been elucidated that juvenile zebrafish prefer even unfamiliar kin to non-kin based on odor cues (Gerlach *et al.* 2007).

Like other vertebrates, zebrafish posses an organized olfactory system that is constantly interacting with the CNS (Whitlock 2006). Studies of both the morphology and chemical neuroanatomy of the adult zebrafish's olfactory structures has shown that it is analogous to the structures found in other vertebrate animals (Byrd & Brunjes 1995). According to Byrd & Brunjes (1995) and Whitlock (2006), these similarities make the zebrafish a good scientific model for studying the mechanisms underlying olfactory behaviors and the maturation of the forebrain in vertebrate animals.

Zebrafish possess two nose-like pores, called nares, which allow water to circulate through the olfactory system (Whitlock 2006). Water enters the olfactory system via the anterior nare and exits via the posterior nare (Whitlock 2006). According to Whitlock (2006), water is driven into the anterior nare via locomotion or by the actively moving cilia found within the olfactory organ. As water enters the anterior nare, chemical compounds in the water interact with distinct olfactory receptors in the olfactory epithelium (Whitlock 2006). The olfactory epithelium of fishes is composed of 3 types of morphologically distinct olfactory sensory neurons (OSNs): ciliated olfactory receptor cells, microvillous olfactory receptor cells, and crypt olfactory receptor cells (Hino *et al.* 2009). Each type of OSN is supposed to express different classes of chemosensory receptors and signal transduction molecules, project axons to different regions of the olfactory bulb, and mediate different physiological responses (Koide *et al.* 2009). In essence, these neurons propagate an electrical impulse when a distinct chemical compound binds to their receptor. This electrical signal then travels to the CNS where it is interpreted and ultimately responded to in a variety of ways that may influence physiology or behavior in a way that is necessary in regards to conditions present in the surrounding environment.

An interesting discovery regarding olfaction in zebrafish was the finding that zebrafish actually have less olfactory receptors than humans (Nemura & Nei 2005). According to Nemura & Nei (2005), humans have approximately 400 olfactory receptors while zebrafish have about 100. This is surprising because zebrafish have been found to have a much more sensitive sense of smell than humans (Nemura & Nei 2005). The reason zebrafish can have less olfactory receptors but still a more sensitive olfactory system may be due to the finding that zebrafish express more diverse olfactory gene families than humans (Nemura & Nei 2005).

Multiple studies been done to determine which odorant substances elicit a response in teleosts. In fish, dissolved amino acids serve as olfaction cues that indicate the presence of food and elicit an attractive response (Koide *et al.* (2009). According to Hino *et al.* (2009), amino acids stimulate at least the microvillous OSNs in zebrafish. It should be noted that a second study showed the amino acids not only stimulate the microvillous OSNs, but also the ciliated OSNs in zebrafish (Hino *et al.* 2009). Koide *et al.* (2009) agree that microvillous OSNs respond to amino acids, which are potential feeding cues. They go on to say that the ciliated OSNs respond to bile acids, which are generally considered to be social pheromones. In contrast, little is known about the function of the crypt OSNs (Koide *et al.* 2009).

Species Recognition in Zebrafish

The documentation of shoaling in zebrafish demonstrates the advantage of social behaviors that species recognition makes possible. Species recognition allows members of the same species to cooperate or affiliate with each other. As seen in zebrafish, cooperation among individuals allows shoaling to occur. This behavior benefits individual zebrafish in multiple ways, such as increasing mating opportunities, reducing competition among conspecifics, and increased defense against predators (Buske & Gerlai 2011). Multiple experiments have determined that shoaling relies on visual and olfactory cues, so it is reasonable to deduce that species recognition must also rely on these factors.

Many experiments have been conducted in order to test the zebrafish's ability to differentiate conspecifics from heterospecifics via olfactory cues. One such experiment by Fabian *et al.* (2007) illustrated that zebrafish can differentiate conspecifics via odor cues and that the addition of humic acid to the environment can inhibit this chemical communication. Humic acid is a naturally occurring organic derivative found in aquatic and terrestrial environments (Fabian *et al.* 2007). When zebrafish were given the choice of untreated water and water treated with humic acid it was determined that the zebrafish preferred the untreated water (Fabian *et al.* 2007). In addition, zebrafish spent significantly more time near conspecifics when in untreated water, but when placed in water treated with humic acid the zebrafish were less inclined to spend time with conspecifics and were observed to spend more time near heterospecifics (Fabian *et al.* 2007). The results of this experiment illustrate that olfactory cues play a role in the recognition of conspecifics and the disruption of the sensory environment can drastically change behavior.

Cross-species Familiarity

The development of familiarity among individuals can bring about benefits, such as increased shoal cohesion which serves to confound predators (Ward *et al.* 2003). Familiarity is dependent on repeated interaction between individuals, thus it develops over time (Ward *et al.* 2003). In an experiment conducted by Ward *et al.* (2003), the ability of shoaling fishes to recognize familiar heterospecifics was tested. Specifically, the researchers wanted to learn the preferences of shoaling fish when given the choice of non-familiar conspecifics versus non-familiar heterospecifics, familiar conspecifics versus non-familiar conspecifics, familiar heterospecifics versus non-familiar heterospecifics, and finally familiar heterospecifics versus non-familiar conspecifics

(Ward *et al*. 2003). Two species of focal fish were used in this experiment: Chub (*Leuciscus cephalus)* and European minnow (*Phoxinus phoxinus).* The test focal fish was placed into a flow tank apparatus which simulated natural conditions for both species (Ward *et al.* 2003). Two separate compartments that contained the stimulus fishes were placed on either end of the tank. These compartments were made of netting material so that olfactory and visual cues could stimulate the focal fish (Ward *et al.* 2003).

The results of this experiment showed that focal fishes were able to recognize and show preferences for familiar individuals, whether these were conspecifics or heterospecifics (Ward *et al.* 2003). In other words, the focal fishes spent significantly more time near familiar fishes regardless of if they were conspecifics or heterospecifics. According to Ward *et al.* (2003), the high levels of predation that juvenile cyprinids experience in their natural environment attributes to this behavior, because associating with familiars in shoals displays more effective anti-predator strategies than non-shoaling behavior.

Kin Recognition in Zebrafish

Kin recognition is an important development because it enables organisms, including zebrafish, to allocate resources or altruistic behavior towards related conspecifics and to avoid mating with close relatives (Gerlach & Lysiak 2006). According to Gerlach and Lysiak (2006), kin recognition and inbreeding avoidance in zebrafish is based on phenotype matching. During early development individuals establish an olfactory, visual, or acoustic template for their kin and compare this template to cues from unfamiliar individuals later in life (Gerlach & Lysiak 2006). In this way, zebrafish are able to recognize even unfamiliar kin (Gerlach & Lysiak 2006). Gerlach and Lysiak (2006) devised an experiment in which they tested the olfactory preference of laboratory-bred juveniles and reproductively active adults by placing them in an odor choice flume. While in this apparatus the test zebrafish was exposed to two different odor cues, one emanating from an upper column and the other from a lower column (Gerlack & Lysiak 2006). The test zebrafish was free to make a choice between the two odor cues (Gerlack & Lysiak 2006). When juvenile zebrafish were given the choice of odor cues originating from conspecifics and heterospecifics they significantly preferred the odor of conspecifics (Gerlack & Lysiak 2006). According to Gerlach and Lysiak (2006), juveniles of mixed-sex groups spent more time on the side of unfamiliar kin than unfamiliar non-kin, indicating that phenotype matching is the basis for kin recognition and preference. Additionally, the juveniles preferred familiar kin to unfamiliar kin,

illustrating that as familiarity with individuals increases so does preference. Finally, Gerlach and Lysiak (2006) determined that these preferences changed with sexual maturity. The researchers found that sexually mature females preferred the odor of unfamiliar, unrelated males to the odor of unfamiliar brothers, indicating inbreeding avoidance (Gerlach & Lysiak 2006). Interestingly, sexually mature males did not show a preference for the odor of related or unrelated females (Gerlach & Lysiak 2006). The results of this experiment elucidate that not only can zebrafish differentiate kin from non-kin and conspecifics from heterospecifics, but that olfactory cues play a major role in the process.

Some of the benefits of kin association include improved growth, fewer aggressive encounters, and the use of a greater proportion of "threat" behavior rather than fighting (Gerlack & Lysiak 2006; Gerlack *et al.* 2007). Improved growth in kin groups has been attributed to the less stressful environment present in these groups (Gerlack *et al.* 2007).

Sex Recognition and Reproduction in Zebrafish

In addition to the other various roles that chemical cues facilitate, researchers have discovered that zebrafish pheromones play a significant role in sex recognition and in many aspects of reproduction. In a relatively simple experiment conducted by Hutter *et al.* (2011), the ability of a female zebrafish to detect a male zebrafish using both visual and chemosensory cues was determined. In this experiment, a female zebrafish was placed into a flow-chamber apparatus that contained a male and female zebrafish. Initially, the researchers created conditions that only provided visual cues to the females. Under these conditions, Hutter *et al.* (2011) found that the females were more attracted to males (but see Etinger *et al*.[2009]) . Further, when the researchers introduced chemosensory cues they found that sex determination improved, thus illustrating that female zebrafish can discriminate the sexes using both visual and olfactory cues (Hutter *et al.* 2011). This discovery implies that by using olfactory cues, zebrafish can find mates even in conditions of decreased visibility.

Another role of pheromones in regards to mating is the discovery that zebrafish pheromones can cause suppression of female reproduction, male enhancement, and synchronization of mating behavior (Gerlach 2006). According to Gerlach (2006), female zebrafish that have been exposed to another female's pheromones for 4 days prior to mating spawn significantly fewer viable eggs than females that were not exposed to another female's pheromones. Gerlach (2006), was able to determine that the

effectiveness of one female's pheromones on another's reproductive success depended on status hierarchy. Dominant females were identified due to their occupation and defense of the largest territory (Gerlach 2006). Dominant females were observed to chase and prevent other females from entering their territory (Gerlach 2006). Based on the findings that dominant females produced significantly more viable eggs than other females, Gerlach (2006) suggests that there must be differences in female sensitivity towards suppressive pheromones. According to Gerlach (2006), the dominant female might release the strongest signal without being sensitive to her own pheromone. In addition, Gerlach (2006), states that there was no physical contact between females, therefore reproductive suppression was solely due to pheromones. Finally, Gerlach (2006) observed that if given the opportunity, female zebrafish will actively avoid other females. Further, if a female was replaced with female pheromone the other female would still display avoidant behavior (Gerlach, 2006). These results indicate that female zebrafish can detect other female's pheromones and will alter their behavior to avoid it.

In regards to male enhancement, Gerlach (2006) discovered that male pheromones can affect female reproduction several days before mating. According to Gerlach (2006), male pheromone can cause ovulation, mating behavior, and significantly improve the number and development of eggs. Even females that were exposed to another female's pheromone had greater reproductive success when exposed to male pheromone (Gerlach 2006). In addition, Gerlach (2006) explains that female pheromone affects males by enhancing spawning behavior, sperm production, and sperm motility. Finally, synchronization of mating behavior and receptivity is achieved when both mating partners are exposed to each other's pheromones for several hours before spawning (Gerlach 2006). The evidence gathered by Gerlach (2006), illustrates that pheromones have a profound effect on the reproductive behavior and success of zebrafish.

II. Materials and Methods

The purpose of this experiment was to determine if zebrafish can recognize conspecifics based on olfactory cues alone. Specifically, zebrafish were tested to determine if they could differentiate the olfactory cues of conspecifics and purple passion danio (*Danio roseus*).

Fish and holding Conditions

Zebrafish (*Danio rerio)* and purple passion danio (*Danio roseus)* of both sexes were used in this experiment. These fish were obtained from a local pet store and kept

together in a 37.85 liter tank. The tank contained gravel, plants and other aquarium materials to enhance the sense of a normal habitat for the fish while not being tested. The tank was kept in a room that had natural sunlight. The water was kept at room temperature. The fish were fed *Tetramin* flakes once daily.

Testing Procedures

During testing, a single zebrafish and two opaque cups that had pin-sized holes punched into the sides were placed in a 37.85 liter tank that contained 9.5L of filtered tap water. One cup contained a male and female zebrafish, while the other contained a male and female purple passion danio. The purpose of the holes was to allow any chemicals produced by the fishes to diffuse into the surrounding water. The tank was set up horizontally and the cups where placed at either ends of the tank . Over a 10-minute period, the test zebrafish was observed and the amount of time it spent near either end of the tank was recorded. After the 10-minute period the test zebrafish was replaced, as well as the water. The discarded zebrafish was placed in a fish tank designated for subjects that already underwent testing. This procedure was done so that there was no chance of reusing the same zebrafish. Control tests were also performed in which one cup was left empty while the other contained a male and female zebrafish or a male and female purple passion danio. In total, 25 trials were run in which the fish tank contained both zebrafish and purple passion danio, 15 trials in which the tank contained only zebrafish, and 15 trials in which the tank contained a test zebrafish and purple passion danio.

Statistics

The statistical significance of the time each test zebrafish spent near either a cup containing conspecifics, purple passion danio, or an empty cup was determined using the Wilcoxon signed-rank test.

III. Results

When a test zebrafish was placed into a fish tank containing cups that held zebrafish and purple passion danio it was determined via the Wilcoxon signed-rank test that it did not spend significantly ($n=25$, $p>0.05$) more time near either of the cups (refer to table 1). Although not significant, on average, the test zebrafish spent slightly more time (5%) near the cup containing purple passion danio than the zebrafish cup. When placed into a tank that had a cup containing zebrafish and an empty cup it was determined via the Wilcoxon signed-rank test that the zebrafish spent significantly ($n=15$, $p<0.05$)

more time near the cup containing zebrafish. On average, the test zebrafish spent 18% more time near the zebrafish cup than the empty cup. When placed into a tank that held a cup containing purple passion danio and an empty cup it was determine via the Wilcoxon signed-rank test that the zebrafish did not spend significantly (n=15, p>0.05) more time near either of the cups.

Stimulus fish(es)	**Avg. time (s) spent near conspecifcs**	**Avg. percentage of time spent near conspecifics**	**Avg. time (s) spent near PPD**	**Avg. percentage of time spent near PPD**	**Avg. time (s) spent near empty cup**	**Avg. percentage of time spent near empty cup**	**Significant? α=0.05**
Zfish & PPD	285	47.5% (n=25)	315	52.5%			No. p>0.05
Zfish	354	59% (n=15)			246	41%	Yes. p<0.05
PPD			295	49% (n=15)	304	51%	No. p>0.05

Table 1: Averaged results including time in seconds and percentage of total time the test zebrafish spent near stimulus fish or the empty cup. Significance of results is also included.

IV. Discussion

Analysis of Results

The results illustrate that the test zebrafish did not have a significant preference for either its conspecifics or the purple passion danio when placed into a fish tank that contained both. Strangely, the test zebrafish, on average, spent more time near the purple passion danio than the other zebrafish. Although this additional time was not significant according to the Wilcoxon signed-rank test, it is still interesting. Perhaps the test zebrafish did not show signs of significant preference towards its own species or the purple passion danio because they were both stored in the same tank. By storing the test fishes in the same tank it may be possible that the zebrafish and purple passion danio developed a degree of chemical familiarity with each other that affected the results of the experiment (Ward *et al.* 2003). Additionally, due to their relatedness, it may be possible that the purple passion danio and zebrafish secrete similar chemical stimuli for species

recognition that are not easily differentiated by the zebrafish. Finally, although the stimulus fishes always consisted of one male and one female, the test zebrafish was not restricted to one sex. According to Gerlach's (2006) research, female zebrafish demonstrate avoidant behavior when a female conspecific is nearby. Since the zebrafish used for testing were not restricted to the male sex it is possible that some of the zebrafish used for testing were female. These test subjects may have avoided their conspecifics due to the presence of another female, thus affecting the results.

The results of the control test in which a test zebrafish was placed in a tank that held a cup containing zebrafish and an empty cup showed that the test zebrafish spent significantly more time near its conspecifics than near the empty cup. These results indicate that the test zebrafish was able to recognize members of its own species via olfactory cues and preferred to spend a significant amount of time near them. This result was expected due to observations of shoaling behavior in the zebrafish's natural environment.

The remaining control test showed that the test zebrafish did not spend significantly more time near the empty cup or the cup containing purple passion danio. During this test a majority of the zebrafish showed a strange behavior that was not observed in the other experiments. Immediately after being transferred from the holding tank to the test tank many of the test zebrafish would move to one side of the tank and remain there, unmoving, for an extended period of time (up to 6 minutes). This was unexpected because in the other tests the test zebrafish, in general, showed much more energetic behavior. The side of the tank that was initially chosen by the test zebrafish appeared to be random. Due to the insignificance of the amount of time spent on either end of the tank these results neither support nor refute the notion that the test zebrafish developed a chemical familiarity with the purple passion danio.

Thoughts on How to Improve this Experiment

In future experiments I would recommend that the experimental fishes be housed in separate fish tanks so that the possibility of familiarization between the different species of fish is eliminated. Additionally, test zebrafish should be restricted to the male sex in order to eliminate the possibility of female-female pheromone interactions that may affect the results. Furthermore, I would allow the cups containing zebrafish and purple passion danio to sit in the fish tank for a longer period of time before adding the test zebrafish, so that their chemical stimuli could diffuse more completely throughout the tank water. If this was done, the first few minutes of the test may have

been different. Finally, I would label the middle section of the tank that was not near either of the cups as "dead space". This "dead space" would not be considered to correspond to either end of the tank that contained the stimulatory fishes. The reason for this is that some of the more energetic test zebrafish would continually pass from one side of tank to the other without getting very close to either cup. This occurrence sometimes made it difficult to record accurate data for the duration the test fish spent on either side of the tank.

Conclusion

The results deemed significant by statistical analysis indicate that zebrafish can identify each other via olfactory cues and when they do they prefer to mingle with each other. This result was expected due to the social behavior of shoaling that zebrafish exhibit in their natural environment. In regard to the question of if zebrafish can differentiate their own species from that of purple passion danio based on chemical stimuli, the answer remains unknown due to non-significant results. To answer this question, this experiment should be redone with the recommendations from section 6.2 in mind.

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Section III:
The Social Sciences

Imagination and Creativity Inside the Classroom

Michael Chicolo (Psychology)[1]

The author discusses the importance of childhood imagination and creativity within the early education setting. Teachers here attempt to make learning more enjoyable for the young children by allowing them to explore creative outlets. Due to less experiences, children rely on their imagination to interact with their world and early childhood centers harness these resources to provide the children with basic tools, which are necessary for the learning process: personal and social experiences. Though, in order to fully grasp the concept of creative teaching styles for early education programs, individuals should understand the research on which the foundation for the centers are built upon. Therefore, in this paper, research on imagination is presented and the author displays its evolution, stretching as far back from the early 1900s all the way to the present time. The research includes theories from Vygotsky (1930/2004; 1966), Myers and Torrance (1961), Mednick (1962), Mendelsohn (1976), Ashiabi (2007), Diachenko (2011), and more. All in all, the research can be summed up as first chronicling the development, processes, and then possible applications of imaginative thinking and the medium of which it is expressed, the act of play. Afterwards, the author discusses the research, as it relates to actual observations made at an early childhood center.

I. Introduction

The Wagner College Early Childhood Center provides young children with pre-K and Kindergarten school experiences. While a loose structure uniformly covers each individual classroom, the Center relies on a different teaching style found within regular educational programs. The teachers, as defined as anyone who "teaches," their desire to teach their students through exploring creative outlets, so as to make learning more enjoyable. Imagination is the key in enabling the children to solve problems or overcome any obstacles in life. At the tender ages between two and six years, the children can only do so much. So, as a result of less experiences and mental resources, they rely on imagination in order to interact with their world through the act of play. Creative

[1] Research performed under the direction of Dr. Miles Groth in partial fulfillment of the Senior Program requirements.

imagination, therefore, is vital for the younglings and the Early Childhood Center harnesses this resource in an effort to influence learning. While completing my placement at the Center, I had witnessed this and had come to believe that childhood imagination is important for both understanding the environment and consequently the learning process. However, before truly understanding how the educational programs can foster creative imagination and aid teaching, one should understand the research upon which this method of teaching is based.

II. Review of Literature

Early Research

While research regarding imagination can be traced all the way back to the origins of psychological studies, this review of that literature dates only to the early 1900s. At this time, a major turning point had occurred on the subject matter with the rise of one of the most prolific researchers. Additionally, early research on the literature about creativity and imagination had a distinct theme. Here, research tended to focus on the development and process of the creative imagination.

More than a century ago, the development of imagination was thought to be related to the development of various ideational types, or mechanisms, by which formulate the imaginative mind. Colvin and Myers (1909) tested each of the different types found within school age children and chronicled their discovery. The results showed that young children think with visual imagery, though auditory and motor imageries were present. As the individuals got older, reliance on visual imagery decreased and verbal imagery increased possibly because the children form the "ability to associate and give meaning to memory material" (Colvin & Myers, 1909, p. 123). Unfortunately, another explanation may be that education funnels students into different types. Results also displayed that children do not think in motor terms often and while auditory imagery increased in later childhood, this related to verbal imagery (inner-speech). Finally, according to Colvin and Myers (1909), the effectiveness of memory correlated with the ideational type utilized by the individuals (i.e. visual type for visual content, auditory type for auditory content, and motor for motor content). This research, even though it was quite broad, would serve as a general template of the literature for decades later.

In the 1930s, scholar and psychologist Lev Vygotsky came onto the scene and completely elaborated on the development of the creative imagination. In one of his

famous works, *Imagination and Creativity in Childhood*, Vygotsky (1930/2004) defined creativity as "any human act that gives rise to something new" (p. 7), allowing the rare inclusion of physical, mental, and emotional acts. Vygotsky (1930/2004) also distinguished between two types of activities which relate to imagination: reproduction and combinatorial. The reproductive act is connected to memory and brain plasticity, which allows the brain to be modified but keep original states with small tweaks, as the person repeats already, mastered skills. In turn, it helps adaptation to a changing world for security reasons. Though, one may glean that if this were the only activity, a person could not change to an evolving world, and only stay stable to it. Therefore, there has to be a combinatorial, or creative activity, which occurs as the brain "reworks elements of past experience and uses them to generate new propositions and new behavior" (Vygotsky, 1930, p. 9). He believed that anyone could be creative and that this 'imagination' was the main component of cultural, artistic, and even scientific life. The scholar then proposes four laws that govern imagination. First, creations are based on previous experience within reality. Everything comes from real experiences, but is then combined into novel ways. Therefore, creative imagination depends on the richness of the previous experiences because real life provides the resources from upon which to build. Second, social experiences broaden and benefit an individual's resources. People are given the information that they do not know yet, enriching resources from beyond their very own personal experiences. Third, a dual expression of feelings exists. That is, emotions have a specific corresponding image and consequently, influence impressions and thoughts. Examples of this are music and art, when the creators attempt to translate their feelings through their projects or when the final project influences the feelings of their respective audiences. Lastly, imagination becomes reality as the imaginative product becomes a new object in the real world, whose existence can then affect other things (e.g., technological invention). In children, these creative laws can be witnessed through their play, where they construct a new reality, bound to their own rules (e.g. playing with dolls, pretending to be someone else).

Additionally, Vygotsky (1930/2004) elaborated on the process of imagination. First, there is external and internal perception of experiences. Next, the individual reworks material by dissociation, the breaking up of impressions into smaller parts and distorting them. This is then followed by association, or the unification of dissociated parts of impressions. Finally, individual elements become a complete whole thought/act. The process officially ends when imagination is crystallized into real world objects. As with Colvin and Myers (1909), Vygotsky (1930/2004) believed that creativity is first

displayed by children through drawing as it is the easiest way to self-express, but by school, they begin to be literary/verbal. With fewer experiences, it is easier to express those simple impressions through drawing. Verbal becomes the choice method for creativity, as language allows for more complex expressions of complex internal impressions that go along with age maturation. Vygotsky (1930/2004) linked the increase of verbal self-expression with the rise of theatrical creativity. Dramatizations and role-play closely corresponds with real experiences and helps the imagination become real. It is a form of interactive storytelling. As a result, education should encourage creativity for its students.

Later Research

The subjects of creativity and imagination, unfortunately, were ignored afterwards. A resurgence of research came about during the later half of the twentieth century. At this time, the later research was characterized by theoretical applications based on new empirical findings on the processes of creativity. In their review of the literature, Barron and Harrington (1981) even grouped the various waves of research into those who focused on divergent abilities, and analogical, imagery, problem finding, and associational abilities.

Branching from Vygotsky's research and suggestions regarding creativity in the classroom, some psychologists guided their own studies to discover the many factors that influence creative imagination. Myers and Torrance (1961) interviewed several teachers as they attempted to follow the five principles for creative teaching. These principles included treating questions with respect, treating imaginative ideas with respect, showing pupils that their ideas have value, occasionally having pupils do something "for practice" without the threat of evaluation, and tying evaluation with causes and consequences. The researchers found that if teachers did not value creativity, it was hard for them to encourage it; predispositions or temperament may prevent creative thinking in the classroom. If creativity was valued, enthusiasm and interest on the topic were reported and in some instances, the students even elaborated on the ideas. Teachers should be alert to opportunities for children to express themselves creatively. When they did not do this, Myers and Torrance (1961) described the teachers as authoritarian, defensive, and insensitive to children's intellectual and emotional needs. They instead valued time, orderliness, respect for authority, and preservation of their self-image. Teachers also should keep the factors that aid (or hinder) creativity in mind. According to Guilford (1962), there are many basic factors or traits that influence creative imagination, such as

fluency (rate of producing ideas), flexibility (ability to change or adapt thinking), and originality (infrequency of a response). Ideational fluency can be broken apart into two types: associational fluency occurs with the completion of relationships, as described as thinking by analogies, and expressional fluency with the actual construction of sentences. Two distinct types of flexibility include spontaneous, which is based on the number and variety of responses, and adaptive, which is the ability to make changes. This adaptive flexibility then relates to the factor of elaboration, which is the ability to diverge and make many new responses based on the original information. The context of the creation also plays a role as some individuals can be creative in one area, but not in another (e.g., verbal vs. symbolic). Underlining these is the way the individuals discover information through cognition and retain the information through memory. Other factors include self-confidence, independency, self-sufficiency, and evaluation, which if strict can handicap but if moderate can lead to higher quality responses. Additionally, Katz (1987) added a high self-concept to the list because these individuals know that they are creative, so it is easier to be divergent. Understanding these characteristics of the creative individual can allow the imagination to be fostered inside the classroom.

Another shift in the research had occurred simultaneously with the resurgence of redefining the creative process in empirical terms. Mednick (1962) paved the way for an associative theory of the creative process, which could be measured through tests. In general, the theory states that creativity is the formation of associative elements into new combinations that have meaning, where the product needs to be useful and not just original. According to Mednick (1962), there are three methods for achieving novel solutions: serendipity, when the answer is accidental, similarity, where a similarity of elements or stimuli exists (e.g. painting, sculpting), and mediation, when common elements mediate associations through the use of symbols, like in mathematics. The theory takes into account individual differences that influence creativity. The individuals need to be aware of the associative materials. When an associative hierarchy exists, the importance of associative elements influence the speed of the solution or the person may continuously exhaust the same resources. Here, stereotyped responses reduce the chance of other associative materials from being used. In this case, for example, a younger person around 25 years of age may hold more creative solutions than older people because they spend less time with the same resources. The number of associations also improves the chances of coming up with creative solutions because there is more with which to work. Finally, personality styles make up some differences. For example, people may take either a perceptual or conceptual approach to the issue at hand or be

either a visualizer (associate memorial images) or verbalizer (associate words). Depending on the criteria set forth to resolve the problem, one style may be suited over the other. Interestingly, Halverson and Waldrop (1974) seem to have supported these conclusions as their studies with preschool and school age children had shown that they deal with barriers in their own characteristic ways (i.e. personality and cognitive styles). Participants were preschool children who attended a nursery school. While they usually entered the school through an outdoor play area, eventually a barrier was introduced in the form of a fence that made a corral around some desired toys. The teachers there showed the children how to knock it down and eventually they began to model the behavior. Five years later a follow-up study was performed, diving into the participants' intelligence, imagination, and social maturity. Results demonstrated that coping with barriers at two-and-half years was not related to coping at seven-and-half years of age. It changed due to unique styles. Conversely, Mendelsohn (1976) argued that creative performance is not associative, but rather attentional. Instead, the researcher believed that individuals search for an answer by using associative materials, such as words, first but then test these out against other words for its "adequacy as a solution" (p. 359). This is trialed until the best is found and, therefore, the individuals must be alert and attentive to the materials in order to make associations. With this theory, creative thinking is not only mere associations; it is also the ability to receive and store accessible information from the environment and the ability to simultaneously think, of which both can broaden resources and increase the likelihood of novel combinations. Many factors would also influence attentional resources, such as availability of elements (e.g. vocabulary levels), accessibility of elements (the ability to retrieve words), goal direction as seen by developments of strategies, and the fluency and flexibility in hypothesis generation. All in all, the ideas mentioned here utilized empirical data to help formulate new conceptions of the creative process and represented a trend of the times.

Near the end of the century, some research began to transition from theoretical applications to applied research. Sternberg (1985) helped usher in this bridge with studies concerned about implicit theories of creativity. Whereas explicit theories are constructions based on observable, testable data of psychological functioning, implicit theories are conceptual and theoretical in nature as they are mere ideas in the minds of investigators (Sternberg, 1985). In the study to understand the implicit theories of intelligence, creativity, and wisdom, he found that creativity is often described by integration, aesthetic taste and imagination, flexibility, and the ability to think in unconventional ways. Intelligence and wisdom were more closely related to one another

than they were to creativity. Therefore, the results had shown that implicit theories could in fact affect people's judgments. That is, adults, including teachers, may hold certain expectations and these in turn may influence attitudes towards particular pupils.

Modern Research – Imagination and Creativity

At the end of the last century and at the beginning of the present century, modern research has focused on the actual application of previous literature and theories inside the educational system.

The main units of the educational system are the teachers as they pass down, usually normative, knowledge to their students. Consequently, researchers were driven to understand their views about creativity in the classroom. Fryer and Collings (1991) interviewed teachers and found that the participants thought that "self-confident," "independent in thinking," and "curious" were creative traits but many did not encourage them in class. Interestingly, creativity, while still understood as self-expression, was not related to divergent thinking, either. However, the teachers did encourage "asking questions" and "attempting difficult tasks," which were also considered creative, as they believed that creativity was rare, but it can be developed. The researchers added that informal teaching and freedom of choice are helpful as well as a pupil-orientated approach compared to instrumental teaching styles. Runco and Johnson's (1993; 2002) research provides an elaboration to those findings. Runco and Johnson (1993) studied implicit theories of children's creativity and found that these are used to judge performances, having both positive and negative consequences on students. Creativity can be fostered if it is accurately assessed (i.e., as active, adventurous, alert, artistic, resourceful) and pushed by adults. Extending their results, Runco and Johnson (2002) found that creativity was related to social desirability. Teachers did not want to be around those creative children who were also "nonconforming" and "impulsive;" they wished to manage the classroom as easily and as efficiently as possible (Westby & Dawson, 1995). Disturbingly, implications of Westby and Dawson's (1995) results mean that attitudes may scare children aware from formal education or creativity may even be suppressed and replaced by conformity.

Gratefully, there are many creative teaching strategies that are applied inside the classroom. Inspired by quality teachers, who valued opinions, self-expression, and communication, Horng, Hong, ChanLin, Chang, and Chu (2005) suggested environments which could ignite the creative, imaginative mind. After performing extensive qualitative research based on interviews, observations, and assessments, the researchers discovered

many characteristics of the teachers, which influenced creative teaching. As for personality, they were open to new experiences, had a desire to acquire knowledge from workshops, and held keen observations at nurturing creative ideas as found in their lesson plans. They noticed that humor comforts students and encourages responses. The teachers tended to promote an easy learning environment through interesting lesson plans, which intrinsically motivated students because learning was more enjoyable. As for the teachers' backgrounds, they had great family support and the freedom to explore nature without punishment for mistakes, which in turn enabled them to creatively learn from errors. Peer interactions seemed to help inspire each other. As for their beliefs in education, they promoted humanistic education, which fostered self-expression and communication through an environment of unrestrained thought and play. All of these characteristics have guided the teachers in utilizing specific strategies. Horng et al. (2005) then went on to suggest environments and strategies they had noticed during their research. Student-centered learning promotes role-play, group discussion, and self-reflection. They also recommended having no hierarchies as these might create dividing barriers between students. Teachers should have access to multi-teaching aids assistance because multimedia and computers attract attention. Class management strategies should provide friendly interactions and a way to express ideas while lessons should be connected to real life for talking about shared experiences and relationships. Eckhoff and Urbach (2008) believed that adults have the power to build a learning environment, which either promotes imaginative thinking or discourages it. Schools must stimulate interest and open experiences by giving young ones the opportunities to face challenging tasks in innovative ways. Smith and Mathur (2009) would add that reading books helps distinguish fantasy from reality, play enhances the enjoyment of learning, and that teachers themselves should engage with the children during storytelling and fantasy play. Smith and Mathur (2009) argued that imagination could reduce anxiety by providing wish fulfillment of prohibited experiences in reality and thusly, it helped make sense of the world. This was why creativity and imagination may lead to positive results for cognitive development, academic success, and emotional regulation. All of these recommendations may increase the rate of creativity and novel responses both inside school and out.

A final crucial aspect of creative imaginative thought in school is active interactions. The child's play should reflect his/her needs at discrete stages. According to Diachenko (2011), there were two types of imagination that split apart during a three stage process: affective imagination acted as a protective mechanism, which regulated

behavior and protected personality as it attempted to remove frustration through imaginary means and cognitive imagination helped "anticipate changes in reality" (p. 20). During two and three years of age, imagination divided into these types, when cognitive imagination could be seen through playing with dolls (e.g. putting to sleep, feeding them) and affective type could be displayed through role-play. At four to five years, the children mastered rules and followed adults. Here, the children formed "staged planning" where they performed actions and recognized consequences. Finally, at six to seven years, imagination was combined with cultural activities. Without guidance, the imagination could lead to obsessions and being stuck in fantasy life. Education, Diachenko (2011) argued, needs to help teach the children to master basic tools that help imagination solve real world creative problems. One way to do this task is by completing crafts. Art helps children to gain aesthetic perspective, express self (including thoughts and emotions), develop language, and coordinate body (Lindqvist, 2003; Uyanik, Inal, Calisandemir, Can-Yasar, & Kandir, 2011). Teachers should guide the children to choose their own materials for the project and the crafts could be collaborative with others to increase respect (Uyanik et al., 2011). As a result, role-play and other forms of activities are important in fostering creativity for young individuals.

All in all, imagination is crucial for not only bolstering creative solutions, but also for helping children understand their environment. Learning depends on personal and social experiences because these build mental resources, the cornerstones of novel solutions. There are many ways in which experiences are formed through the imaginative mind. Theatrical creativity allows the children to incorporate past experiences in new situations, and letting their imagination run wild in the real world (Vygotsky, 1930/2004). Demonstrations of this can be explicitly found as children play games, such as "house," have a picnic, or even pretend to be a band of heroes. Additionally, children can show signs of Diachenko's (2011) affective and cognitive imagination types. Children's artistic creativity, as displayed by sculpturing Play-Doh, constructing with blocks, and hand drawing scribbles, can be explained by both associational and attentional theories of the creative process (Mednick, 1962; Mendelsohn, 1976) and can allow them to self-express during the learning process. In each situation, the imaginative mind and subsequent creativity help children interact with the world. Early childhood centers use this reliance on the imaginative world to help teach children in unusual ways. Teachers there support and reward creative efforts through role-play, art, and reading. In the end, this focus of teaching can have many positive results, such as increased counting and reading skills, as well as better social

skills. When the right conditions are met, early childhood centers and their educational programs may play a significant role in child development by providing the basic tools, which are necessary for the learning process- personal and social experiences, whether they be real or imaginary.

Modern Research – The Act of Play

Much research today also has focused on the use of play inside the classroom. Despite its important relations with imagination, play has only been hinted at thus far. So, it is about time that the act of playing is discussed, because play is crucial for imagination and broadening resources. According to Vygotsky (1966), play is the reproduction of real scenarios, which includes both cognitive processes and affective situations, all the while containing a set of rules that govern behavior based on reality. Vygotsky (1966) argued that play is not the predominant form of activity during the preschool age but it is the leading form of development for children as it helps create a zone of proximal development, where the children's individual needs are satisfied. He believed that this concept was demonstrated through the incentives and motivations to act. Toddlers desire immediate gratification and usually obtain it from adults, but as they get older at the preschool level, needs are not always realized. Therefore, play is wish fulfillment, where unrealizable needs are recognized, put on hold, and retained. Play realizes these needs within the imaginative aspects of conscious activity. Consequently, for young children, these motivations for play are hidden as they are connected to generalized affects towards the environment, while adolescents are able to explain why they play. Provocatively, imaginative play frees the child from situational constraints and ideas guide actions towards objects during the process of imagination, as opposed to actions being guided by the objects themselves. In this case, the meaning of an object is transferred to another, but the action is more important than the meaning. Take, for example, a child riding a substitute stick for a horse. The meaning of the real horse is transferred to the stick, but it is the action of riding that can create new experiences and broaden resources. As a result, the act of play allows creativity and imagination to become expressed.

Play is very beneficial for children as it helps aid the imagination and allows them to form creative solutions to overcome obstacles. In a qualitative review of previous research on play, Ashiabi (2007) summarized its various outcomes. Socioemotional characteristics are enhanced and so are the child's capabilities to reflect before acting and understand both his/her and others' emotions. When with other

children, the child learns about negotiation as a way of fairly communicating with peers and using compromise as a solution to conflict. Similarly, methods of cooperation are improved. The researcher even suggests that evidence for these benefits come from observing children working together on the same task. This is also one way creative problem solving is encouraged. Socially, perspective taking and role taking gradually form through play. Sociodramatic play enforces the child's abilities to "take the perspective of others, understand their pretend and real emotions, and be able to regulate his/her actions accordingly" (Ashiabi, 2007, p. 203). Conjointly, role taking is improved and the child begins to develop "a sensitivity to the needs and views of others" (Ashiabi, 2007, p. 203). Additionally, the child begins to understand how to sustain relationships by practicing sharing, turn-taking, self-restraint, and working in a group. Finally, pretend play allows the child to recognize mental states in others and distinguish between imagination and reality. Some researchers add that play preferences can aid sensory processing during the preschool age. For example, in a study observing three to five year olds with toys, Lawson and Dunn (2008) hypothesized that those who sought sensations exhibit higher levels of play because children who avoid stimulation have "less variation of body positions during play" (p. 10) and are less likely to get up to get more toys if already comfortable. Contrastingly, results found that those who sought sensory stimulation in fact did not show higher activity levels. Instead, he found that children with different sensory patterns preferred different toys. Children desiring less sensation enjoyed miniature pretend toys, which could be described as miniature versions of real things usually where the child gets to sit down (e.g., trains). Children desiring more sensation engaged with creative art toys, building toys, or even had no preference (here, the children may have either gotten bored or easily habituated to stimulation, so just moved on to another toy). When building materials were used, the children would build together and many times they crashed their creations, which may have to do with socialization (side note: play dough was most popular material). Finally, Myck-Wayne (2010) distinguished between two types of play, each with their own learning opportunities. There was dramatic/pretend play, which facilitated social and emotional skills, such as following directions, group participation, empathy, and attention span, language and literacy skills, such as verbalization and comprehension, and cognitive and academic skills, such as problem solving and creativity. Exploratory/manipulative play assisted similar skills in sensory learning, the development of vocabulary and categorization, and not surprisingly, higher-level thinking as children sought to

understand the physical world (p. 19). As a result, play benefits the children by allowing the opportunity to interact with both the real and imagined world.

Interestingly, despite the children's reliance on play as a means to externalize their internal imagination and understand their world, genders tend to have separate play preferences. In a study of three and five year old children, Freeman (2007) found that the participants distinguished between 'girl' and 'boy' toys. The children were interviewed by the researcher and asked if specific toys were meant for boys or for girls. Both three year old boys and girls agreed that the skateboard, motorcycle, and baseball were boy toys and that the tea set, doll, and gown were girl toys, but the boys were not unanimous at this time. The boys also thought that their parents would be less accepting of playing with the girl toys and the same was said by girls with boy toys. The five year old children, on the other hand, all agreed on the same gender-specific toys and also thought that cross gender toy play would be much more unacceptable than the three year olds. Even though these findings support gender-typical choices, the study contained an extremely small sample size, so generalizing beyond the sample is problematic. However, research does back up such a claim. According to Holmes and Procaccino (2009), different types of playgrounds offer different opportunities and resources for play. Contemporary playgrounds are improved traditional playgrounds, which consist of wide-open spaces for gross motor skills and physical play. These include slides, jungle gyms, suspension bridges, sandboxes, swings, and areas for wheeled vehicles such as bicycles. When Holmes and Procaccino (2009) observed three and four year old preschoolers for 40 days out of a school year at such a playground, they found that boys played in the riding area twice as much as girls and that girls played in the sandbox more than boys (every other area was the same for both genders). Swings were frequently visited by both girls and boys and the researchers believe that this was possibly due to the swing area encouraging mixed-sex interactions. According to Tulviste and Koor (2005), genders are also governed by two different regulations. Moral rules regard issues of justice and protection, while social conventions regulate social interaction. In their study of four and five year olds in real life same-sex play, the researchers hypothesized that girls, similar to mothers, refer to conventions and boys, being rougher, refer to morals. Tulviste and Koor (2005) observed same-sex dyads at a daycare center, which contained stereotypically feminine toys, such as dolls or a kitchen play set, and masculine toys, such as cars or blocks. Results showed that boys used significantly more moral rules than the girls, especially when it came to the notion of justice, and they focused disputes on the destruction of property. Girls, on the other hand, referred to the teacher as an

authority figure, thus exhibiting some conventions. Taken together, all of this may reflect effects of socialization. In Freeman's (2007) study, the researcher noticed that the younger children were slightly more accepting of cross gender toy play than the older children and suggested that media and old stereotypes from culture may perpetuate gender stereotypes towards the toys. Consequently, society and adults may unintentionally create gender preferences amongst play.

Finally, the most recent research considers what has already been learned about the act of play and, much like imagination and creativity, attempts to apply it at early childhood centers. Simultaneous to encouraging free play in the center, teachers should also discourage gender stereotypes, or at least their expression through gender play preferences. Ashiabi (2007) recommends teacher-guided play because it promotes diversity and appreciation to various beliefs, traditions, and abilities. Teachers should subtly nudge children to handle different books and toys- those meant for different genders, ages, or cultures. As for the teachers themselves, they must adapt to children's activities. This includes guiding the playgroup, arranging props, and reminding children of their assigned roles during pretend/dramatic play. DiCarlo and Vagianos (2009) might agree with those recommendations as they, too, push for teacher guidance in a number of ways. Interest centers contain learning opportunities by providing play materials for enhancing development skills and the researchers believe that teachers should make the most of interest centers. Teachers should allow children to play with a variety of materials in order to help develop different skills (e.g., practice writing skills, drawing or labeling art works). Teachers should then observe engagement within the centers. That is, they should keep track of the types of toys each child handles and their interaction with said toy. This, in turn, would help identify toy preferences, such as those with sensory qualities (auditory, tactile, visual, movement, etc.). With this information, the teachers need to guide interactions with the toys so that the child obtains the most sensory feedback from it and the teacher can even modify the centers to appeal to each individual child. Lastly, teachers can provide choices within each center by utilizing distinct play styles, such as adult prompting, where the teacher assists the child with verbal, visual, and interactive prompts, or solitary exploration, where the teacher adds preferred qualities into low-interest centers to grab the child's attention. Gmitrova, Podhajecka, and Gmitrov (2009) add that teachers should guide pretend play inside the classroom. The researchers found that children age three to six prefer pretend play and that this should act as a "transfer of knowledge and skills" (p. 349). They characterized pretend play as including role-taking, improvisation, and script knowledge because objects and

actions are transformed symbolically. Gmitrova, Podhajecka, and Gmitrov (2009) go on to suggest that teachers select pretend play relating to lessons of the day and encourage cognitive and emotional gain from the experience. All of this research regarding teacher-guided play relates to 'Good-fit' teacher-child play interactions. According to Trawick-Smith and Dziurgot (2010), the 'good-fit' model is a Vygotskian influenced model, where the teacher first observes play and attempts to determine the child's needs. There then must be a "good-fit" interaction where the child receives just the support that is needed" (p. 111). As a result, this can enable the teacher to withdraw from the play and should encourage autonomous play for the child. Trawick-Smith and Dziurgot (2010) tested the model and not only did results confirm their hypothesis that it can lead to successful autonomous play, but they also found that distinct levels of needs could be identified (much need, some need, no need) and that this coincides with Vygotsky's "Zone of Proximal Development," which essentially is the 'good-fit' model. Specific types of play needs for either some or much need of support (p. 114) include engagement (e.g., expressing difficulty in making a play choice, displaying random behavior, wandering classroom as if unengaged), task performance (e.g., seeking help, showing difficulty in physically manipulating materials), thinking (e.g., requesting help in problem solving), social participation (e.g., interest in peer's play without joining in, isolated play, difficulty communicating ideas verbally), social conflicts (e.g., complaining, disrupting play of others), rules (e.g., violating rules, ignoring teacher), and adult contact (e.g., seeking contact with adult by initiating conversation, publicly showing accomplishments for praise). The researchers even discovered different levels of adult guidance (p. 115), including direct (e.g., instructing child, initiating new play activity, settling disputes), indirect guidance (e.g., suggesting play options, hints, conversing about play, ask questions, model task, encouraging child to join peers), observations, and no interaction at all. Teachers and adults have to be aware of these needs and satisfy the child with the right amount of assistance. Taking everything into account, Goble, Martin, Hanish, and Fabes (2012) studied gender-typed activities, which are defined as girls preferring feminine activities and boys preferring masculine activities, though, these vary within the social context or who the child interacts with at a given time. Basing their hypothesis on Gender Schema Theory, the generalization that children identify with their own gender and are motivated to learn about it by observations and imitating behavior, the researchers believed that in solitary play, gender-typed activities would be pursued more frequently than when playing with others of the opposite gender (mixed-type), where activities would be more neutral. Goble, Martin, Hanish, and Fabes (2012) observed

preschool children enrolled at a Head Start Program and found that the children played alone and exhibited gender-typed activities. Girls played with feminine and neutral activities more than masculine ones, such as balls, blocks, vehicles, or superhero pretend play. Instead, girls played with art materials, music, puzzles, or dolls, dressed-up, and pretended to be either mothers or teachers. They additionally enjoyed the neutral activities involving clay, board games, animal pretend play, or water/sand sensory centers. The researchers took notice that the play activities related to typical developmental skills. The masculine activities help aid spatial and mathematical skills and the feminine helps language. These are also known as the typical strengths of each respective gender. So, it is suggested that teachers encourage both gender activities. In this manner, they discourage gender typical play styles and preferences and enable the children to learn from various styles, each enhancing a different skill that may not typically be developed as properly.

Conclusively, play is the medium through which individuals exert their imagination and creativity. Play realizes unmet needs within a reproduction of real scenarios (Vygotsky, 1966). Children benefit so much from play. Ashiabi (2007) recognized the many advantages of play- its socioemotional improvements, its perspective taking, and its cooperative relationships. Meanwhile other research, such as Lawson and Dunn (2008), demonstrates assistance in sensory processing. Unfortunately, it seems that society may perpetuate preferences among playing habits. Freeman (2007) found that children do, in fact, distinguish between toys meant for boys and those meant for girls. Compounding these findings is Tulviste and Koor's (2005) observations that boys are guided by moral rules, especially concerning justice, and girls are governed by social conventions. Essentially, these are stereotypical behaviors of each gender; men "are supposed to be" aggressive protectors and women "are supposed to be" socialites. Understandably, researchers today are trying to apply what is known about play into educational classrooms. Teachers must guide play activities, discourage gender stereotypes, and encourage diversity among playmates (e.g., Ashiabi, 2007; DiCarlo & Vagianos, 2009; Goble, Martin, Hanish, & Fabes, 2012). Thus, keeping in mind all of these recommendations should optimize play and enable children to use their imagination, as they seek to understand their perceived world.

III. Observations

Observations were taken at the Early Childhood Center at Wagner College. The children's ages ranged from two to five years old, but I mostly followed the older

children who attended the entire five-hour day. Despite multiple classes (half-day or full day) and age differences, the structure of the classes was kept exactly the same. The morning began with reading books and then the first "circle time" had occurred where the teacher taught the lessons of the day. Next, the children played freely at the various centers and completed an art project related to the lessons of the day. After lunch and the second "circle time," the children were taken to the playground where they could run around. At this time, the younger class, who were two to three years old, and the older class, who were four to five years old, interacted with one another. The day officially ended with snack time and rest time. While observing there, I had realized that their creative imaginations could be placed into three separate themes: theatrical creativity, artistic creativity, and athletic creativity.

Theatrical creativity took the form of fantasy role-play at the different centers during free playtime. The first significant fantasy-play emerged during my second week at the center. I was still becoming comfortable around the children. Weirdly enough or coincidentally, it seems that I had gone through an initiation of some sort. Some of the boys played "barbershop" and acted as barbers as they pretended to cut my hair as I sat in a chair (smock, powder, and all)! Afterwards, those children began to finally remember my name. A more popular role-play was that of superheroes, especially *Power Rangers*, *Batman*, *Spiderman*, and many others. Sometimes, the boys allowed the girls partake in their activities and other times not so much, but with a little push by teachers, the girls eventually were able to join the group. Similar to the stories, the children patrolled the room, and made sure to place any delinquents into jail, which would only be a corner of the room. Less often, on a couple of occasions, I played superheroes with Henry using toy cars. He wished to pretend to be *Batman* and my car was designated as his sidekick, *Robin*. Together, we fought the villains who tried to destroy the "Batcave," which had been constructed by a few wooden blocks. At this point, "superheroes" is a very popular theme. Additionally, one of my weeks there, it was fire safety week. Exclusively at this time, these lessons propelled the children to play firefighter and pretend to put out fires, which were represented by piles of toys. One more way the children displayed their sense of role-play was by the traditional game of "house." On one occasion, some of the kids pretended to be a family. Ali, Robert, Jean, and Scott stood at the toy kitchen set and took care of the household as mom, dad, daughter, and son, respectively. The parents cooked the food while their 'children' hung 'outside' with friends. The parents then called them in when lunch was ready. Interestingly, as with previous experiences, the hot dog bun seems to be understood as the universal cell phone replacement. They then

wished to go on vacation, and used the wooden boat to get to their destination. However, others desired to ride in the boat and decided to kick them out, but luckily, the others were persuaded to "wait for the next boat." On a separate occasion, Charles, Katherine, Jean, Scott, and Alexander also played "house." The kids made a birthday cake and sang the "Happy Birthday" song to each of their friends. They then proceeded to prepare the food for a picnic while pretending to watch a *Batman* movie. The kids cooked soup, made sandwiches, and packaged other foods. There was a basket that they used to carry all of it, including dishes and utensils, to another spot on the floor. Watching the children place the foods inside of it was reminiscent of a puzzle. In order to fit it all inside the basket, things were shuffled, rearranged, taken out, and replaced. When the picnic began, the tablecloth was placed on the floor, dishes were given out to each of them, and they unpacked the food. Despite sharing troubles among all of the children, these individuals gratefully shared the food with others who asked to join the party. All in all, these ages are very imaginative group, dramatizing real life and fictitious scenarios.

Contrastingly, the younger children are just as creative, though, this is relative to their resources. These children were the complete opposite of the older group. They mostly had a difficult time listening and staying still. Each one took toys without asking those who were already playing with them. However, these kids also had an easier time giving them up to their friends compared to their older counterparts. However personality differs, creative imagination was on par. Kurt, who only attends for the half-day classes at the center, had made an egg for me in the kitchen. He handed the egg to me in a cup along with a fork, dish, and shockingly a candle presumably to heat the egg at the table where I would be eating. While observing the full-day younger ones, the children decided to work together and invent a two-row train. They each placed chairs beside one another, creating two adjacent rows of seats. Then two of them grabbed the front seats with dishes in hand. Those naturally were the conductors, who drove the train filled with passengers.

Artistic creativity is the second type that I had witnessed during my weeks at the center. Many areas, or "centers," placed all around the classroom supported the children's artistry. One section held blocks of all kinds. There were soft, colorful ones, wooden ones of various shapes and sizes, and even simple, cardboard brick-looking ones. Sometimes these were all combined to create the project and other times they were left alone. The boy, James, displayed much skill in these activities. He had built a grand castle out of the wooden blocks one time. It was both a very complex structure and aesthetically pleasing to the eye, especially compared to the simpler castles some of the

other kids had built. Though, these simple structures by Carol and Anna have progressively become more intricate. While quite plain in the beginning, their buildings made from the soft blocks changed to be tall, long, and full of archways. Once near the end of the observations, Anna created a short, but long, home with rows of triangles acting as a giant roof and round blocks spread apart on the top for a nice design. Again with the wooden blocks, a group of boys collaborated on what one of them named, "Hot Wheels World." The group drove cars through a crazy racetrack with all kinds of obstacles and ramps. Elaborating on their idea another day, the group built a much bigger ramp, driving their respective cars over the blocks, grabbing hang-time off the ramp, and performing tricks. One time, when they wished for me to play with them, I needed to drive my car on the blocks and into the soft block barriers- hitting the floor meant that the car had plunged into the ocean and it needed rescuing. Another instance had Charles and Lucas building a regular racetrack. Here, the track had no verticality, but it took up much space on the floor with its many various separating routes, which were narrow, wide, smooth, or rocky. A similar center held the Legos. Legos are not much different than the blocks; their defining feature is lockable, usually much tinier pieces allowing the individuals to create small models. Here, there seems to be two defining structures. Some desired to build tall skyscrapers, or factory-like buildings. Others, such as Robert, highly preferred creating a farm. They built the corrals for the Lego animal figurines and even played with them, making their respective animal noises. One of the few exceptions was the construction of spaceships. These took the appearance of futuristic planes and were then flown around in dogfights, trying to shoot down the bad guys.

Another method by which the children were able to express their artistic creativity was through craft projects. The Play-Doh table was very popular amongst the crowd. Unlike the model constructions, these art works were simple, but just as enjoyable. Henry really loved to flatten the clay to make huge pancakes. He even pulled his resources together with friends like Rachel in order to make it even bigger. Henry also entertained the idea to flatten out the clay so as to stencil a bunch of shapes (e.g. ghost, dolphin, pumpkin). Perplexingly, to do this, he made a big round ball and then flattened with his hands opposed to simply flattening it first. When it became so thin that a hole formed, he rolled the piece back up and began the procedure again. For some reason, he could not fathom of plugging the hole up with more Play-Doh. Surprisingly, the children did not know how to mold snakes. So one day, I stepped in and taught the children tips about rolling and flattening the clay to make them. They picked them up

quite quickly. Additionally, Janet once molded a pizza with pepperoni dots. For a rare one day, the Play-Doh table was replaced with what I would call the 'peg' table. For this craft, one would create art by placing colored pegs onto the board. All of the children here had one goal in mind: instead of making some kind of picture, they desired to just fill up the board. However, one boy, James, the same boy who constructed the "grand castle," created a pattern with the colors (e.g. green-blue on one side of the rectangle and yellow-red on the other). Unfortunately, he stopped only to continue to fill the board up. Sometimes, distractions got the better of them. Besides the Play-Doh, the children had to complete a daily art project. These pertained to the lessons of the day. They had a letter book, in which the children, now more than ever like students, practiced writing the alphabet. They also colored in pictures (literally, they try their hardest to color within the lines) related to the lessons. Noticeably, even if they might enjoy the project, they did not like to leave their friends during the free playtime.

Compared to the older children, the younger ones' imagination seems to be just as creative to some extents. Their creativeness is not limited by their mental age, but instead by their chronological age. It seems to be all relative. For example, the kids built basic structures from the Legos and soft blocks, such as towers (not yet called skyscrapers) and castles respectively. Trains and swords were made from stackable pegs. These children appeared to enjoy the art projects, waiting their turns at the table and just drawing on extra sheets of paper. While the older ones may have enjoyed the crafts, they rather have played with the toys. Also, at this time one of the kids, Neal, wanted me to draw with him. So, I began to draw Tweety Bird when suddenly I messed it up. Neal asked what I was doing and I told him. He replied by telling me to just copy him. The extent of the art drawings was scribbles and circles filling every space on the paper. All in all, the young children's artwork tends to be more chaotic.

The final type of creativity that I was able to observe occurred throughout my time at the playground: athletic creativity. I personally consider athleticism to be creative; these skills can still be used in novel ways to work around problem solving. The playground was set up to easily accommodate the children. The center of the vicinity had a swing set on one side and a jungle gym, with its multiple crazy slides to go down and tunnels to crawl through, on the other. Sandboxes and model houses each were located at the ends. Not only was the playground tailored for running around but little tricycles and balls could be taken out from the sheds. Occasionally, the teachers had extra activities to do, such as collecting leaves or blowing bubbles. Well, I have observed much during these periods. The older children had no troubles riding the bikes.

However, the younger ones could not reach the pedal or could not ride it. What was their solution? The children opted to plant their feet on the ground and just thrust themselves forward. However, sometimes I did offer to help push them along from the back, in an attempt to teach them how to pedal. When it came to the balls, the children and I performed the basics: either catching or kicking the ball around ("soccer" as they called it). For the most part, coordination seemed to be a work in progress, but the smiles on their faces demonstrated that they still had fun and were still eager to play the game. Another instance had me playing catch with Henry. He is very athletic; the kid was good at throwing and catching the ball as well as having the ability to kick the ball with great accuracy. Other children who joined in at later times, though, lacked the ability to do these things. Accuracy was far off or the balls hit the ground much earlier before reaching the person. Oddly enough, I had witnessed one girl, Carol, ingeniously decide to throw the ball from over her head and take one step forward for power. As I am speaking about specific individuals, there is one more I should note. Neal was adventurous to say the least. He was not afraid of anything and loved to utilize the entire playground. He went down the slide head first despite multiple warnings and before doing it, I have caught him looking at the teachers, almost if he wanted to be caught. He knew those boundaries and wished to see how far he could have pushed them. The sandbox is worth one final mention. The children did not use this area often, and if it was occupied, then only the same few kids were filling up the pails with sand. The sandbox tended to be a mundane, relaxing place. In the end, it was the one place to get away from all the chaos.

IV. Discussion

According to Vygotsky (1930/2004), theatrical creativity is practiced by most, if not all, children because it closely relates to actual real world experiences. In its wake, real experiences are re-imagined and brought back into reality in its new form. In his writings, Vygotsky referred to this type of creativity as staging plays. However, there really is no significant difference from fantasy or role-playing. They are one in the same as the processes are similar and they both allow the children to relive previous experiences. Staged plays enable the children to embody, prepare and even improvise pre-existing material. The children at the Early Childhood Center accomplished all of these with the one exception being no script to follow. They reeled in own prior experiences, most likely learned from home, and concocted their own imaginative play. While playing "house," the children embodied their respective roles. The parents cooked

the food and cleaned the dishes while taking care of their sons and daughters. The children hung out with their friends, waiting to be called inside the house when lunch was ready to eat. Accordingly, none of these roles were prepared. Each child improvised and made the character their own creations. In other words, the children responded to one another instead of following a script. As Vygotsky (1930/2004) defined theatrical creativity as dramatizations, this description also incorporates the act of story telling. A major aspect of the childhood center was to encourage reading. At the start of the semester, the children had teachers read them books that they had chosen themselves. As time progressed, the kids then began to read to themselves and one another. Though, while some tried their hardest to accurately read the books, others instead decided to make the story up as they went along, basing the interpretation of the story on the pictures. Dramatization is definitely a major aspect of children's imagination.

The more recent research on preschoolers' imagination by Diachenko (2011) can also be applied to the children at the center. There are two types of imagination. Affective imagination is a protective mechanism, which resolves struggles between ego and the environment. It regulates behavior as it attempts to remove frustration through imaginary means (that is, remove the threat to the ego, which can happen if one cannot adjust the ego to societal demands). Cognitive imagination helps decipher and anticipate future events. According to Diachenko's (2011) developmental stages, at two and a half to three years of age, the imagination divides into these types. Example of cognitive imagination at this stage is reproducing actions with dolls. The girls at the center showed this often. They fed, carried, and patted the dolls, and eventually put them to sleep. An example of affective imagination is reproducing feelings. The boys, while pretending to be heroes, showed this as the criminals 'feared' (hid) from the good guys. At four to five years of age, the child masters rules and follows the orders of adults. Cognitive imagination at this stage is associated with role-play, painting, and games, but these could become only reproductions if not guided by others. Affective imagination is associated with feelings found within real experiences. At this stage, "staged planning" emerges as the children perform thought up actions and recognize consequences. Those at the center clearly displayed this concept. Some of their actions and decisions were disregarding rules or other friends (usually sharing issues). They were then warned, and sometimes the kids did abide to the teachers' orders to immediately stop. There is a third stage for those between six and seven years of age, where culture's influence on the child is reflected in play and planning can be modified, but this had yet to be observed at the center.

The children in both age groups also prominently expressed artistic creativity. According to Vygotsky (1930/2004), drawing is the primary form of creativity in early childhood, because it is simple and easy to express simple impressions that young children have due to less experiences. Therefore, the drawings for younger children are more abstract and less detailed than older children. Drawing is a more widely acceptable art form. This was the case for those at the center. The younger children highly enjoyed the art projects. Each could not wait for their turn, so they decided to draw as a way to pass time. These were usually scribbles and basic geometric shapes, but to them, the works were personal stories to tell the world. Better yet, the arts and crafts for this age group disguised life lessons. Each project taught the kids something. For example, one craft had the kids produce owl masks from paper plates. This project helped teach the class cutting with scissors, as they had to shape the owl's mouth. The art projects for the older class were quite different. These supplemented the lessons of the day, as opposed to directly teaching new skills. While the older class did enjoy the art, they had rather continue playing with their friends. This is in accordance with Vygotsky (1930/2004), who stated that the innate desire to draw gradually extinguishes as age increases and language is learned. These children are able to understand words, or abstract symbols which represent their feelings and thoughts, clearer. Additionally, Uyanik et al. (2011) believed that education guides children to think by allowing them to choose which materials to use for an art project. Specifically, the teachers at the center had heeded these rules. The children in both classes held the freedom to choose materials. Instructors set criteria for guidance, but then the children had the freedom to create within those limits, choosing markers/crayons or locations for pieces to glue, for example. At this time, the teachers also assisted the children through prompting, as suggested by DiCarlo and Vagianos (2009). Along with the actual art project relating to lessons of the day, the children needed to practice writing. This exercise was sometimes included on the actual project or drawing or they had a "letter book" to complete. The teachers patiently assisted them in the task. They would verbally guide the children in writing letters and demonstrate it by first writing the letters and then allowing them to model movements. Afterwards, some of the children were able to write themselves (this, of course, had no bearing on their understanding of the alphabet- they knew letters, but could not neatly make them). Finally, the Play-Doh crafts relate to Mednick's (1962) association theory of creativity. The sculpting represents the method of similarity for achieving creative solutions. The products (e.g. pancakes, pizzas, snakes) were all inspired by and associated with real world objects. Conversely, the Play-Doh crafts may

relate to the attentional theory of creativity (Mendelsohn, 1976). The children could have thought of relationships between the clay materials and images that could have been molded with it. They could have searched through their entire mental catalogue of vocabulary and images and then picked the best solution. However, this is difficult to digest. This theory could work flawlessly for problem solving; it makes sense. Contrastingly, in the case of sculpting, there is no problem. The molder freely chooses to sculpt the object. There are no criteria to guide attentional thinking along the lines of relationships. Direct associations with previous experiences and real world objects are more likely. Oddly enough, the boys who handled constructing materials would build together, but then crashed their creations into one another in accordance to Lawson and Dunn (2008). This was especially true for the boys who crafted spaceship or airplane models. After building the airships, they pretended to be in a dogfight with the end result a head-on collision. Either way, artistic creativity is vital for self-expression during childhood.

Athletic creativity is expressed as individuals use skills and talents to overcome obstacles. Every person holds unique skill sets and the way these are utilized could generate novel or even deviant solutions to dilemmas. Well, Uyanik et al. (2011) supported the initiative that students should experience "active learning" inside the schools, which was defined as learning by "doing, experiencing, and experimenting" (p. 113). Under this definition, exercise and outside play could be classified as active learning. The observations at the playground have established that the children could and have adapted to situations. Many instances of these included playing with the balls. When throwing and catching the balls, the children had some difficulties, but still insisted on trying different techniques. Henry alternated from throwing overhand to throwing underhand. He was able to throw it higher and further. Carol threw the ball from over her head to increase power, when she could not reach her target friends. At times, some of the children could not catch the ball correctly. Instead, they adopted the approach of letting it bounce before grabbing the ball. Riding in the Little Tykes cars and riding the bikes, the children pushed each other if one of them had difficulties. If they could not get up the small mounds of dirt, the kids dismounted, dragged the bike over the hills, and then proceeded to ride the bike. Contrary to the research, it seemed as if the outdoor period at the contemporary playground on the grounds of Wagner College was less polarizing then Holmes and Procaccino's (2009) initial observations. This playground contained the usual slides, suspension bridge, sandbox, house, swings, and bikes. However, each was equally occupied by the boys and girls. If anyone sat at the sandbox,

which the children often ignored, it was a place for both genders. Same could be said for the swings, which happened to be quite possibly the most visited area by the children. Both genders also rode the bicycles, even if the boys did so for longer intervals of time. Even though the children seemed closer to same-sex peers, interactions, for the most part, were of the mixed-sex type. Athletic creativity, therefore, allows individuals to solve problems with their unique talents.

Generally speaking, the children did unfortunately show signs of gender differences among play styles. The findings of Goble, Martin, Hanish, and Fabes (2012) can be applied to the children at the center. The girls did interact more with feminine and neutral activities. They became more involved with art materials. Almost guaranteed, at some point each day, Rachel, Anna, and Janet stopped at the Play-Doh center. More often than not, Anna, Janet, and Carol, who were generally the only girls that handled building material, almost exclusively played with the soft, colorful blocks. Also, the girls crowded around the art table when they had all of the other centers to visit. If role-playing, the girls made it a hobby to either be mothers to dolls or to be sisters. Interacting with the farmhouse and toy animals was also common among certain girls. Contrastingly, only a small portion of the boys played with the animals or puppets for a short period of time after joining the girls and then quickly leaving them. The boys played with masculine activities. Many of them played with building materials. While James and Scott would play with any construction toys, the rest of them thoroughly enjoyed the blocks. These usually were the wooden ones, but they would reach for the soft blocks if they ran out of the wooden blocks. The boys loved to drive toy cars around tracks that they had created from the blocks. In some instances, they would believe that the cars were fighting villains or hiding from zombies. Finally, the boys did not pretend to be fathers, unlike the girls who were mothers. Instead, they were always "good guys." That is, they, similar to the girls who wore princess dresses, dressed up as heroes, such as law enforcement or firefighters, or pretended to be super heroes, such as *Power Rangers*. Regulating this play, as foresaw by Tulviste and Koor (2005), were different sets of rules for each gender. The boys were definitely into moral rules of justice. As pretend heroes, they would lock classmates into jail (the perpetrators had to stay behind a table). If a creation were destroyed intentionally or accidentally, they would tell the teacher what had happened. The girls, on the other hand, relied on social conventions. They stuck together and lived by social rules. As a result, gender differences in play preferences and styles were prominent.

In the end, however, imagination and creativity does not matter if adults do not encourage these essential concepts. Luckily, through an institutional perspective, it seems that the Early Childhood Center at Wagner College as a whole has developed many ways to cultivate the children's imaginative capabilities. The Center promoted a loose structure for the classes. Usually, the morning began with reading, then was followed by learning activities, free playtime, playground time, and then ended with time for resting. This provided an opportunity for the children to be able to adapt to the regular structure of future school programs. Though, despite being regimented, the children were allowed to diverge from common thinking patterns in order to solve problems and build new constructions. This had occurred throughout the school day. In accordance to Horng et al. (2005), the organizational environment held no hierarchies because this would create dividing barriers between students and extinguish the possibility of open discussions. During library time, the children read books of their choice. They either read with friends together or alone. Occasionally, especially for the first handful of weeks, the teachers, including graduate assistants, engaged with the storytelling. The children would be active readers, as the teachers would ask them questions pertaining to the story, numbers, colors, and more. Free playtime gave the kids the opportunity to fantasy role-play, which according to Smith and Mathur (2009) can enhance the enjoyment of the learning experience. By teaching lessons and then applying those lessons within art projects, the Center attempted to make learning more fun. Better yet, the Center in this respect can relate to Uyanik et al.'s (2011) suggestions for completing crafts. These art projects, for the most part, utilize disposable waste materials, such as paper, leaves, and buttons. The teachers also guide the children to think by making them choose which pieces of the material to use for the project. Uyanik et al. (2011) believed that this may improve self-esteem as they can make their own decisions and as the art projects are collaborative with the teachers, these cultivate respect for others. Additionally, the teachers themselves are the basic unit of the classroom. In order for an institution to continue to encourage creativity, the teachers must believe in the cause. Fortunately, all of these teachers promoted imaginative creativity. The children were very much rewarded for their creative efforts. The teachers would compliment them on their constructions and even take photographs every now and then. Gladly, opposite of the research from Fryer and Collings (1991), they desired their students to be independent thinkers and self-confident and they encouraged difficult tasks and asking questions. Once again, parallel to Horng et al. (2005), the teachers focused on student-centered learning. That is, each individual child was given attention and the

freedom to reflect on various issues at hand. They were rarely identified as a group, but rather individuals, who were part of the group and who brought there own unique talents to help shape it. This was specifically displayed when each teacher would work one on one with the child on the art projects or when one of the children were having trouble setting something up during playtime. The teachers then encouraged a variety of activities to aid different developmental skills and consequently guided play, as suggested by Ashiabi (2007) and Trawick-Smith and Dziurgot (2010). They promoted an appreciation for differing cultures by providing books and games for different genders, ages, and backgrounds. For example, some books were for older children with a more developed vocabulary, while others were for younger audiences. On the culture front, some books introduced the children to Spanish culture or near the holiday, some reading material helped them understand Kwanza. Throughout the day, teachers either directly or indirectly guided activities. They instructed the child in tasks, settled disputes while teaching them to share or wait for a turn, or began a new activity with the child. They rarely passed up the opportunity to ask the child a question, but if the child could not respond, hints were inevitable. If a child was having a hard time adjusting in the beginning of the year, they either played with them or encouraged the child to interact with his/her peers. Undeniably, the Early Childhood Center would make these researchers proud by providing a stimulating environment for imaginative thought and play.

V. Summary and Conclusions

All in all, imagination is crucial for not only bolstering creative solutions, but also for helping children understand their environment. Learning depends on personal and social experiences because these build mental resources, the cornerstones of novel solutions. There are many ways in which experiences are formed through the imaginative mind. Theatrical creativity allows the children to incorporate past experiences in new situations, and letting their imagination run wild in the real world (Vygotsky, 1930/2004). Demonstrations of this can be explicitly found as the children play games, such as "house," have a picnic, or even pretend to be a band of heroes. Additionally, the children had showed signs of Diachenko's (2011) affective and cognitive imagination types. The children's artistic creativity, as displayed by sculpturing Play-Doh, constructing with blocks, and hand drawing scribbles, can be explained by both associational and attentional theories of the creative process (Mednick, 1962; Mendelsohn, 1976). Finally, the athleticism at the playground supported Uyanik et

al.'s (2011) idea of active learning. In each situation, the imaginative mind and subsequent creativity helped the children interact with the world.

This interaction with the world is, of course, exercised through play. As Vygotsky (1966) characterized play as a reproduction of real events, including cognitive processes and affects, play is one method for an individual to express creativity by allowing their imagination to fuse with the real world. However, optimized play may be impeded by society as it influences play preferences. It seems that boys prefer masculine toys (e.g., balls, action figures, construction toys) and girls prefer feminine (e.g., dolls, crafts) (Goble, Martin, Hanish, & Fabes, 2012). They are even governed by separate rules relating to their respective gender stereotypes; boys, being a protector, follow rules of justice and girls, being socialites, follow social conventions (Tulviste & Koor, 2005). Though, teachers at the Early Childhood Center are safeguarding this problem by encouraging all kinds of play for the learning experience. They are engaging with the children, assisting in play through guidance, and most importantly, providing the opportunities to play and be creative (e.g., Ashiabi, 2007; DiCarlo & Vagianos, 2009; Trawick-Smith & Dziurgot, 2010). Each child there receives a proportionate amount of support and a 'good-fit' interaction is achieved successfully (Trawick-Smith & Dziurgot, 2010). In this way, the children can truly benefit from playing.

In the end, the Early Childhood Center and its teachers were accomplishing what they set out to do: teach young children while enriching their mental resources through imagination and creativity. Formal teaching lessons included alphabets, words associated with those letters, numbers, and facts regarding important occasions. However, these were then elaborated through art assignments and various readings, which allowed the children to self-express throughout the learning process. Playtime gave the children the opportunity to explore their inner imagination even more fully. Best of all, these conditions were highly encouraged and rewarded by the teachers, as they gave the children the attention that they deserved. The results of these methods were remarkable as they reflect the literature. During only a few month period observing at the Center, the children showed signs of learning. Counting skills rapidly increased, as well as associating words with images (that is, vocabulary was enhanced). The children formed a greater desire to read by themselves. Architectural designs of block and Lego structures evolved to be more intricate. Those who were shier than others became more sociable among their friends. The list can roll further down. In essence, this thesis supports that, when the right conditions are met, early childhood centers and their educational programs can play a significant role in child development by providing those

very basic tools, which are necessary for the learning process- personal and social experiences, whether they be real or unreal. Imagine that!

VI. References

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Section IV:
Critical Essays

Invisible Women: Female Comic Book Superheroes and Their Artists

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"Like the crash of thunder from the sky comes the Wonder Woman, to save the world from the hatreds and wars of men in a man-made world!" (Marston 1). Thus reads the first line of *Sensation Comics #1*, Wonder Woman's first solo comic. This one phrase was all it took to set the wheels in motion for several decades' worth of comic book heroines. Comic books are a unique medium in that the visuals are equally as important to telling the story as the written words. Unfortunately, while they may ostensibly be strong female characters, superheroines have historically been portrayed in a problematic way. Their costumes, anatomies, and poses in particular show them as over-sexualized objects of the male gaze. The problematic representation of women in comic books can largely be explained by the fact that most comic book artists are male and assume a male audience. The recent growth in women comic book artists will likely help to change the representation of women comic book characters.

When asking a fan to name a comic book artist, one might hear names like Jack Kirby, Steve Ditko, or Will Eisner. Rarely will mention be made of Trina Robbins, Jill Thompson, or Colleen Doran. Until very recently, female comics creators have been totally underrepresented in the industry. One statistic estimated that about 20 percent of students at the Joe Kubert School of Art are females hoping to break into the comics business (Katz 114). Clearly, there is an interest on the part of the artists. However, exclusionary practices do still occur. The aptly titled "Why Have There Been No Great Women Comic-Book Artists?" discusses a 2005 exhibit at Los Angeles' Museum of Contemporary art entitled "Masters of American Comics." Of the 15 artists showcased in the exhibit, not one was female (Berwick 1). One could, of course, mark this exclusion down to the fact that there have been historically few women working as comic book artists. However, in the past few decades, women have been rising to higher positions within the industry. DC Comics at one time employed female publishers, editors, writers, and artists (O'Shea 92). This progress, unfortunately, has not lasted long. After DC launched a massive reboot of all of their titles in 2011, only two of the almost one

[1] Written under the direction of Dr. Laura Morowitz AH324(H): *Women in the Visual Arts*.

hundred comics creators were women (Simone 17). One must wonder, then, if women are equally as qualified and willing to work in this industry, why are they being shut out?

Women are often told by parents, by the media, even by publishing companies themselves that comic books are not for them. Superheroes are too action-oriented, filled with tense battles and bright explosions. If a girl *must* read a comic book, she should try something like *Archie* or *True Romance* where cartoonish characters play out uninspired love triangles that never seem to make much headway (Waid 7). This thought is so ingrained in societal thought that artist Colleen Doran cannot recall one convention that she has attended where at least one man, often in the comics business himself, has not tried to dissuade her from her career because women could not possibly be interested in superheroes (Doran 205).

Aside from just their supposed disinterest in comic books, female artists are often seen as too different from male artists to tell these stories in a way which fans will respond to. Women are thought to be more detailed and draw with softer, more fluid lines (Berwick 1). Others think of women as less likely to draw characters to fit the male fantasy of the assumed audience. Multiple creators have acknowledged that women are more likely to focus on characters' personal lives and the relationships they have with each other while males tend to focus more on action scenes (Katz 137, 115). These of course, if true, are at the very least generalizations which should have very little effect on a fan's ability to enjoy a book. One of the most egregious reasons put forward is that women are simply unable to tell a story visually. The basis for this line of thinking is apparently that because men enjoy pornography while women do not, women are therefore unable to connect with any visual medium (Doran 204). Statements like this demonstrate exactly why women are not only rejected from the comic book industry, but would not want to enter into such a world in the first place.

Besides the identity of comic book creators, the assumed audience is also an important factor for why female superheroes are depicted the way they are. Ultimately, comics are a business and publishing companies must make a profit. Unfortunately, it seems that publishers have made no real effort to determine the actual percentage of their readers who are female. According to a 1995 survey of comic book stores, 13.41 percent of customers were female. Of these, most were between 25 and 35 years old, far older than the adolescent males that publishers and the media both seem to assume as the prevalent readers of comic books (Emad 969-970). This, now almost 20 year old survey, is certainly a low estimate for the current number of female readers. Yet, the visual depiction of female superheroes is clearly targeted towards adolescent males, a practice

which does a great disservice not only to comics' women readers, but to their adult male readers, by far the largest group.

Also underrepresented in comics are, perhaps most significantly, female superheroes at all. For a long time, if a woman was seen in a comic book she was simply the girlfriend or mother or doting aunt of the hero. She was constantly put in life threatening situations; her only purpose was to motivate the hero to spring into action or to be a villain's leverage to catch the hero in a trap. The women who were heroes were few and far between. Countless teams had one token girl whose only discernible trait was that she was, in fact, a woman. The original lineup of the Avengers had the Wasp, the Fantastic Four had the Invisible Girl, and the first team of X-Men had Marvel Girl (Thomas 18, 56, 58.). These women were often vapid and had little personality. In fact, the few lines that the Wasp has in the first issues of *The Avengers* are about how "dreamy" Thor is or how she could not join a battle because she was busy powdering her nose (S. Lee 11, 97). The heroines who had their own books usually made out slightly better, but this was not always the case. In fact, of the seven consistently published comic series since the 1930s and 40s, *Wonder Woman* is the only book with a female protagonist (Emad 956).

Figure 1. Johns, Geoff (w.), et al. *Countdown to Infinite Crisis*. (March 2005) DC Comics.

One of the most obvious issues in regards to the depiction of women in comic books is their costumes. With few exceptions, female superheroes are typically shown in as little clothing as possible. Male artists drawing for a male audience design these outfits to fit in with a fantasy that they perceive as relevant to all fans, regardless of whether or not this is actually true. At best, these costumes are impractical for fighting crime or almost any other activity. At worst, they are exploitative and reinforce negative societal ideals. One often cited example is the costume of Power Girl (Figure 1). Power Girl wears a white, long-sleeved leotard with blue gloves and a red cape, a typical color scheme for superheroes. The suit is skin-tight and rides up almost to excess in the pelvic region, but these are typical traits of comic book costumes. The real issue with Power

Girl's outfit is what is commonly referred to by fans as her "boob window." In the middle of her chest, there is a large circle cut out of the fabric which serves no discernible function other than to display her cleavage. The contrast between the white costume and the color of Power Girl's skin immediately draws the viewer's eye to her breasts. It distracts from the action of the story, sending the subconscious message that her breasts are the only part of her worth paying any attention to.

Another massively controversial costume comes from DC's New 52, an event in which the company restarted the entire DC Universe with all new stories and origins for their many classic heroes. Starfire is a hero who was previously a member of the Teen Titans and can now be seen in the series *Red Hood and the Outlaws*. Her previous costume was itself extremely revealing, but artist Kenneth Rocafort managed to give the new incarnation of Starfire even less clothes (Figure 2). Only her nipples and pelvic region are covered, and then only by thin lines of fabric. In the first issue of *Red Hood and the Outlaws*, Starfire is shown in a bathing suit at the beach which, astonishingly, covers even less of her body (Lobdell 10). While this type of costuming would be extremely problematic on any heroine, it is especially damaging for a hero best known as a member of an all-teen superhero group. In a popular article from when the issue was published, a seven year-old fan felt disappointed that "she's not doing anything but wearing a tiny bikini to get attention…I want her to be a hero, fighting things and be[ing] strong and helping people…Because she's what inspires me to be good" (M. Lee 1).

Figure 2. Lobdell, Scott (w.) and Kenneth Rocafort (p.). "I Fought the Law and Kicked Its Butt." *Red Hood and the Outlaws* #1. (Nov 2011). DC Comics.

As one might expect, female comic book artists tend to draw heroines with more modest, more practical costumes. In 2011, a group of female comics creators put together an anthology of comics done only by women called *Womanthology*. One story is about a teen girl with superpowers on her first mission who calls herself Lady Power Punch. She attempts to join a superhero team, but is told that she cannot because the team already has a female hero. The artist uses this second heroine to highlight what makes Lady Power Punch so different. Lady Power Punch's costume has short sleeves and a skirt that drops slightly above the knee. Perceptra, the other heroine, wears a traditional superheroine leotard with no sleeves and ample cleavage. She is tall and thin with long blonde hair, whereas Lady Power Punch is of an average height and weight and has unstyled brown hair (De Liz 20). Other heroes within the anthology are shown in jumpsuits, another typical costume for female heroes. Unlike heroines drawn by male heroes, however, these women's clothing is loose fitting and appears easy to move in. One imagines that someone like the Invisible Woman could barely walk in spandex that tight, let alone fight crime!

Aside from costuming, another major issue of depicting women superheroes is posing. Male artists typically seem to favor showing women from farther away, so that as much of their bodies can be seen as possible. Women's bodies are often contorted into impossible positions. One popular pose has women pushing their breasts out as far as possible while doing the same with their buttocks, to show both off as well as they can. This same pose also twists the women's body to the point where realistically her spine would break, so that as much of her breasts and buttocks can be seen as the artist can draw (Figure 3). When this pose does not fit, women are typically shown from behind, often bent over or with their legs spread

Figure 3. Liefeld, Rob. *Liefeld Creations*. Rob Liefeld, 2012. Web. 30 Nov. 2012.

wide, as though ready for sex. In one panel, Banshee is shown with all three of these qualities. Just a few panels later, she is shown again, this time in close up. Her head is tilted back, eyes closed, lips slightly parted. Without reading her dialogue, about a particularly upsetting vision she has just had, one might assume she is in the throes of passion (Figure 4). In fact, it seems that almost every convention of the pose has been orchestrated by male artists to make male readers subconsciously associate these female superheroes with sex. The only non-sexual, typical pose is the damsel-in-distress pose in which the woman has her arms around the neck of the man who carries her in his arms (Figure 5). When both characters are supposed to be heroes, the implication is just as problematic as any over sexualized pose.

Figure 4. Busiek, Kurt (w.) and Vince Mielcarek (p.) "What if Professor X Had Become the Juggernaut?" *What If*... Vol. 2. #13. (May 1990). Marvel Comics.

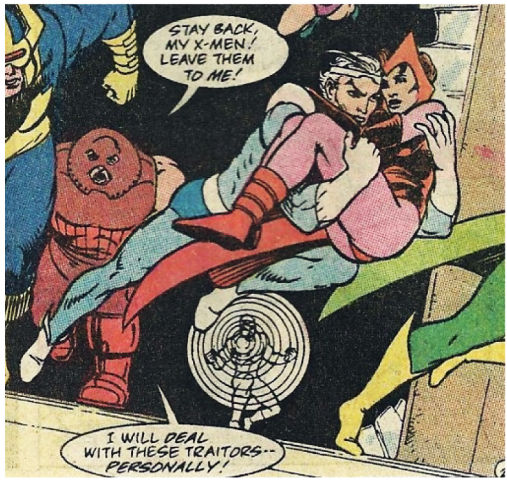

Figure 5. Busiek, Kurt (w.) and Vince Mielcarek (p.) "What if Professor X Had Become the Juggernaut?" *What If*... Vol. 2. #13. (May 1990). Marvel Comics.

A prime example of male artists' issues with pose has been Guillem March's art in DC Comic's New 52 *Catwoman* series. The first issue begins with Catwoman hastily dressing herself. Each panel is a close up, several of which focus on her bright red bra. One panel shows her running from a man shooting in her direction. Here, the focus is on her buttocks as the panel cuts off everything above and much below them. Most distressing is the fact that her face is not even shown until the third page of the issue and

her clothes aren't fully on until page five! Catwoman's personality and intellect are clearly not in focus here (Winick 1-5). Again, the Lady Power Punch comic from *Womanthology* is the perfect contrast. On her way from her high school to the battle, Lady Power Punch must change into her superhero costume (Figure 6). Like the *Catwoman* page, each panel shows a close up of Lady Power Punch getting dressed. Instead of focusing on her breasts, the artist chooses to focus on her back, arms, feet, and face. As she puts on her costume, Lady Power Punch pleads, "Please fit. Please fit," the exact opposite, and frankly more realistic, sentiment of the one shown in the *Catwoman* panels (De Liz 19). The cover of another *Catwoman* issue by March incorporates nearly all of the issues discussed in the previous paragraph (Figure 7). In a pose that completely defies the laws of physics, Catwoman has somehow managed to contort her body in a way that allows her face, breasts, and buttocks to be seen simultaneously. This shocking disregard for basic anatomy points to exactly what the artist feels truly matters about Catwoman.

Figure 6. De Liz, Renae (w., a.) and Ruffino, Nei (c.) "Lady Power Punch." *Womanthology: Heroic*. Eds. Renae De Liz, Laura Morley, and Jessica Hickman. New York: IDW Publishing, 2012. 18-22. Print.

One of the most noticeable differences in the art of male and female comic book artists is seen in almost every story in *Womanthology*. By an overwhelming majority, the artists here seem to focus in on characters' faces (De Liz, et al.). By doing so, the artist can show a much wider range of emotion and character depth than the empty expressions of traditional male art. In addition, by showing heroines in close up, these artists are taking the emphasis away from the women's bodies. They are no longer the subject of male sexual fantasy, as their sexuality is no longer on display. A particularly clever story uses a gender reversal of one of the most traditional female poses. A heroine's boyfriend has been kidnapped by a villain for leverage. The classic image of the hero carrying the damsel to safety is recreated here with the heroine carrying her boyfriend off unharmed (Fortuner 198). Women artists seem to recognize certain tropes used time and time again in comic books and are able to reverse them and use them to their own storytelling advantage.

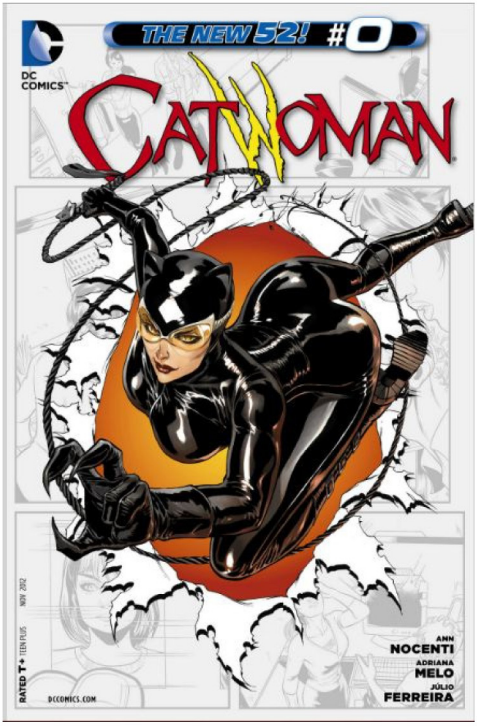

Figure 7. March, Guillem (p.) and Tomeu Morey (c.). "Zip Me Up." *Catwoman* #0. (Nov. 2012). DC Comics.

Not only do male artists tend to depict women in physically impossible poses, they often give them physically improbable bodies. Countless pages show women with stick-thin waists and breasts as large as their heads. One of the worst offenders in terms of comic book art is Rob Liefeld. He is well known by comic book fans to be one of the worst, yet most successful, artists in the industry. Characters of any gender are subject to Liefeld's poor anatomical skills and impractical costumes, but his women often receive the worst treatment. One such example is shown on the cover of his *Badrock* series (Figure 3). First, her legs are cut off slightly below the knee, meaning that they must extend about a foot or so further. In proportion to the rest of her body, this would make it nearly impossible for her to walk. Unlike most Liefeld women, this one seems to have reasonably sized breasts. However, it would be very difficult for a waist thinner than her legs to hold them up, especially considering she could not possibly have a spine if she was truly in such a pose. Liefeld is clearly an extreme case, but his success has certainly caused others in the industry to follow his unbelievably problematic example. For the female fans that make it past everything else preventing them from reading these books, women like this are sure to give them unrealistic expectations of the type of body they should have.

Women, on the other hand, tend to draw characters with body types that real women have. The heroines in *Womanthology* have, overall, a tendency towards smaller breast sizes or, at the very least, breasts that can be supported by the rest of their bodies. While none of the women in this anthology are necessarily obese, more than one appears slightly overweight and very few seem to fit in with the typical one hundred pounds or less model that seems to run rampant with mainstream superheroes. Some of the women,

such as Lady Power Punch in the panel described earlier, are body conscious. They wear clothes that flatter, but not clothes that flaunt (De Liz, et al.). They are, for all intents and purposes, *women*. The female superheroes of Rob Liefeld and other male artists are not women. They are an unrealistic, male-driven ideal. Women artists create realistic women characters because they know exactly what it is to be a young girl paging through her favorite issue of *Supergirl* wondering why she does not look like that. They are in a unique position to create positive female role models and seem generally to do so with flying colors.

No discussion of women in comics would be complete without a mention of Wonder Woman. She is often cited as the quintessential female superhero. In fact, most people would probably have difficulty naming any others. In her original incarnation, Wonder Woman's costume had many of its traditional elements. She wears a gold headband, silver bracelets, and her classic red bustier. Instead of the blue bathing suit bottoms that most think of her as wearing, however, she wore a short skirt in the same pattern (Marston 1-13). While certainly racy for the time, this costume is slightly more modest and more feminine than her classic attire. Her body is more proportional as well. Compared to today's depictions of Wonder Woman, she is still extremely thin, but her breasts are in proportionate size with the rest of her body. This successful handling of Wonder Woman's body in these early comics does not, however, prevent two women in *Sensation Comics #1* from referring to the heroine as a "hussy" and a "brazen thing" (Marston 2).

The handling of Wonder Woman in her early incarnations is a testament to the fact that, while the tropes generalized in this paper hold true in many cases, they are just that: generalizations. William Marston, the creator of Wonder Woman, said that the character was an answer to the "bloodcurdling masculinity" inherent in the comic books industry (Emad 957). In a particularly impressive panel, Wonder Woman carries the wounded Steve Trevor to the hospital in a reversal of the classic damsel-in-distress pose (Figure 8). Unlike the similar pose seen in the *Womanthology*, this panel was drawn by a man. The difference between male and female artists, then, is far more artificial than publishing companies would have their readers believe. There are men capable of depicting women in a successful way. All that is needed is the opportunity.

Figure 8. Marston, William Moulton (w.), Harry G. Peter (a.). "Wonder Woman." *Sensation Comics* #1. (Jan. 1942). DC Comics.

One particularly pertinent story from *Womanthology* is entitled "In Every Heart A Masterwork." It tells the story of a young girl, no more than seven or eight years old, who covets her older brother's comic books. She sneaks into his room to read them and finds stories about zombies, a battle between superheroes, and a scantily clad woman fighting a dragon. While her brother is away, she "fixes" his comics. Drawing new additions to the pages, she glues clothes onto the woman, smiles onto the zombies, and a picture of herself holding hands with the superheroes to stop their fighting (Figure 9). This young girl is a stand-in for every female comic book creator. Dissatisfied with typical male art in comic books, women must take matters into their own hands. It seems the only way for female fans to get what they truly want out of comic books is to make their own.

Figure 9: “In Every Heart A Masterwork.” *Womanthology: Heroic*.

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Antigone's Hero

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In the play *Antigone* by Sophocles, though it would seem obvious that the would-be tragic hero is Antigone, it is actually King Creon. Creon displays certain character traits that present him as a better candidate for the position. Antigone can never be nominated simply because she does not meet all of the requirements needed to be fulfilled, although she does embody the greek paradigm. The Greek Paradigm, in short, is living piously and revering the gods while knowing one's destiny.

As outlined in Aristotle's *Poetics*, a tragic hero has certain criteria that must be met in order to qualify for the title. A major classification of a tragic hero is that they must be noble. This does not directly infer that the hero is "of high moral standard" or a king. Noble could mean that they are "larger than life" or "majestic" beings (Brown). A tragic hero must possess a fatal flaw that causes the initial dilemma in the play. This flaw must be clearly showcased and almost make the hero seem villainess. A tragic hero must have an "action with serious implications" (Aristotle/ Elements). The mistake can be either intentional or unintentional but needs to "give form to universal truths" (Aristotle/ Elements). It also needs to further incriminate the hero just in time for the third quality of a tragic hero: they need to show regret for their harmful actions and suffer the consequences. By suffering these tragic consequences, this ultimately will lead them to "catharsis" and a "purification" from all the wicked emotions in their body (Aristotle/ Elements).

The beginning of the play sets the scene with Antigone showing distress over her brothers' deaths. She announces the new King Creon's edict which states that her brother, Polyneices, cannot be buried for the crimes he has committed and must rot above the ground, his soul never being put to rest. Antigone knows that this is impious because the eternal laws of the gods say that all of the dead must be buried so that they can face Hades in the afterlife. This, essentially, is Creon's hamartia- his need to establish his authority over the people and the fact that he will disgrace his gods to do it. This is similar to Pentheus in *The Bacchae* in that both kings are disgracing their religion. They

[1] Written under the direction of Dr. John Danisi for the Reflective Tutorial associated with LC-9: *Minds, Machines, and Human Beings*.

are acting against the Greek paradigm which states that to be a good, wise person, you must know your destiny and revere the gods completely without any questions or judgments. Creon does not know his destiny. He does not follow the unbreakable, eternal rules laid out for generations by the gods, but instead unwittingly creates his own rules that, in his opinion, have precedence over those made by the gods.

Antigone, on the other hand, has a flaw too. Antigone does not respect her place in society as a woman who should not interfere in politics, nor tell the king what to do. In her decision to bury her brother she says "the time in which I must please those that are dead is longer than I must please those of this world" (Sophocles, line 76-77). In her mind burying Polyneices is what she needs to do. She finds herself more connected to the dead now because she believes that this is her true destiny. She must stand up to the king and lay her brother to rest so that his soul may be in peace. She is brought to the king after performing the sacred burial and does not show any remorse for her wrongdoings. The chorus notices in her speech "the savage spirit of a savage father" (Sophocles, line 471). Although Antigone is trying to live in terms of the Greek paradigm and follow the eternal laws laid out by the gods centuries ago, she still has no humility when facing the king. She says "I did not believe your proclamation had such power to enable one who will someday die to override God's ordinances, unwritten and secure" (Sophocles, line 452-455). She is reminding him that he does not have the status that the gods do and cannot enact laws that outweigh those of the gods. Creon sees that in her declaration "she laughs at what she did" (Sophocles, line 483) and releases her with a final sentiment - "love the dead" (Sophocles, line 525).

Creon does well with epitomizing the second characteristic; he is a man of many mistakes. "A [great] man who is neither a paragon of virtue and justice nor undergoes the change to misfortune through any real badness or wickedness but because of some mistake" (Aristotle/ Elements) was said by Aristotle in his work, *Poetics*, when describing a tragic hero and the blunders made by the like. This quote is saying that a great man doesn't change completely to evil because he is truly wicked; it is only because of a bad situation that forces this change. This takes much blame off of the hero because the audience can connect with said hero more.

Everyone makes mistakes, this is a universal notion. Teiresias says "all men make mistakes; but, once mistaken, a man is no longer stupid nor accursed. It is obstinacy that convicts of folly" (Sophocles, lines 1022-1027). Stubbornness is what truly makes the mistake an evil one. True evilness is not something that can be overcome, but mistakes are easily remedied once the adamancy to resolve overshadows the reluctance to

surrender. Creon's son Haemon confronts his father to point out his lapse when making such an edict. Haemon represents the connection between the royals and the people of Thebes and all of their morals and views. He explains "it is natural for me to be watchful on your behalf concerning what all men say or do or find to blame" (Sophocles, lines 688-689). He tries to explain to his father that the people do not respect Creon's edict or punishment laid out for Antigone. "The city mourns for this girl; they think she is dying most wrongly and undeservedly for the most glorious acts" (Sophocles, lines 693-695). Although Haemon makes it clear he does not share this view and "only values his father's success" (Sophocles, line701) he still is trying to cause his father to have a realization that his "acts are mistaken and unjust" (Sophocles, line 743).

What Haemon doesn't realize is that he is not talking to his father, but to his king. Even when he goes so far as to pronounce his impending suicide proceeding Antigone's demise, Creon only sees this as a threat. This is why Creon forgoes stoning Antigone, which was the original punishment for the assailant, but decides to force her into a cave to die of starvation. This, in Creon's mind, "avoids the city of pollution" (Sophocles, line 775) meaning they will not see him as the cause of her death and will not then be angered at Creon. Haemon leaves with a bitter statement: "you would be a fine dictator of a desert" (Sophocles, line 739).

Although Antigone does have a fatal flaw that leads to her demise, she is never showcased as a villain. Actually, she is someone admired through the story for standing up for her brother and also for the gods. Throughout the whole play the chorus is torn over their loyalty for Creon and sympathy for Antigone. The chorus lets known that their original "hope stretched over the last roots of Oedipus' house, and the bloody dust do to the gods below has mowed it down - that and the folly of speech and ruin's enchantment of the mind" (Sophocles, lines 599-603). This exhibits their disappointment in not only Antigone, but ultimately the gods for what they chose to be not only Antigone's destiny, but her family's destiny as well. They see all of the evil that has befallen the Oedipus family and only hope that it will end; yet it never seems to. However the chorus cannot "control their tears when they see Antigone making her way to her bed that is the rest for everyone" (Sophocles, line 801-806). The chorus and the people also admire Antigone because she exemplifies her belief in the Greek paradigm, proving her unwavering devotion to the gods and all of their laws. She gives up her life and goes to her death with "distinction and praise" (Sophocles, line 818) believing either that the gods will save her or that she is now done with life and meant to die, to fulfill her destiny. This is a clear strike against Antigone as the tragic hero because at some point an audience must lose all

hope in one's tragic hero so that they can redeem themselves and make a true exoneration.

Teiresias visits Creon and wisely states that "you are on the razor edge of danger" (Sophocles, lines 995-996) and that for all Creon's "acts of violence, the avenging spirits of Death itself and the gods' furies shall after your deeds lie in ambush for you and their hands you shall be taken cruelly" (Sophocles lines 1074-1078). He is saying that all of Creon's impiety and harmful actions will be returned to him with the same amount of wretchedness. This leads to Creon's realization of all he has done. Though he does not want to, he knows he must "yield" (Sophocles, line 1102) and "keep the old accepted laws" (Sophocles, line 1114).He knows that Teiresias is wise and respects his advice. From there he knows that he must undo all of the wrongs he has committed. Creon tries to save Antigone by going to the cave to release her. Yet he finds that she is already dead. Haemon is also in the cave. He attacks his father, then kills himself. After hearing of her son's death, the new Queen too takes her life. The final grievance done by Creon, placing the living below the ground with the dead, completed his twisted, impious cycle of actions. Creon portrays a huge amount of arrogance in his new role as king and this leads to justice weighed down with three deaths. Creon must at that point look upon the consequences of his actions and face them. Just like Aristotle says, "A man cannot become a hero until he can see the root of his own downfall" (Aristotle and the Elements). This is the point where the purification must begin. In the end, Creon does have a realization of all the wrong that he has done. He sees how his hand was the main culprit in all of these violent ends.

Antigone has no self-realization. To her, she committed no wrongs. She did what she had to do and supported the gods completely. As she walks to her death she tells the people to "pity me. Neither among the living not the dead do I have a home in common, neither with the living nor the dead" (Sophocles, lines 850-852). She repeats herself for emphasis that she is now outcast and subjected to an eternity of aloneness because of King Creon. Antigone "descends, alive, to that world alone" (Sophocles, lines 822-823). She can never again be with the living because she is not alive, nor can she be with the dead because she is trapped above ground with no chance of peace for her soul. She says "I go down in the worst death of all - for I have not lived the due term of my life. But when I come to that other world my hope is strong" (Sophocles, lines 895-897). Because she did die for her beliefs, the audience holds her in high regard. This makes her out to be a martyr because of all that she gave up due to her love for the gods and for the dead.

The Chorus ends the play with these final words: "...great words of haughty men exact in retribution blown as great and in old age teach wisdom" (Sophocles, lines 1350-1352). This statement depicts the final stages of Creon's purification. He has had his realization and will now change his ways by living the Greek paradigm. He realizes his destiny, acknowledges and repents for his mistakes, and changes ways into a truly pious man. From this point forward Creon will live with reverence to the gods. He will not repeat his mistakes and try to enact civil law over eternal law. "All men make mistakes, but a good man yields when he knows his course is wrong, and repairs the evil. The only crime is pride" (Sophocles, lines 1023-1030). Here, Teiresias describes Creon exactly because he is a man who makes mistakes but in the end, although a bit late, he yields and has good intentions when trying to repair his own wretchedness. Looking at the situation from a Kantian perspective, his biggest crime was indeed pride and this lead to his family's downfall. However, since he did redirect his intentions, he saved himself and ended up not in the wrong even though things ended badly.

Antigone's final cries as she enters her tomb to die do unravel her overall piety and confidence minutely. She asked "What law of God have I broken?" (Sophocles, line 921). This makes it hard for her to be pitied because here, she is not living the Greek paradigm. She is now questioning the gods and her destiny and therefore acting impiously towards the gods who she so righteously defended with such reverence only days before. She begins questioning all of her actions because it now becomes clear that she expected something from the gods in return for her momentary devotion. She believed to be entitled to her life because of the sacrifice she was willing to make. In the end, she had no idea that her "pious" acts would result with her dead in a tomb.

Antigone is a sort of ironic title because the actual tragic hero of Antigone caused her demise. A hero, according to the *American Heritage Dictionary* is "a man endowed with great courage and strength, celebrated for his bold exploits and favored by the gods" (American Heritage Dictionary). Antigone is clearly up to par with this definition. She goes against all social standards by confronting Creon and is respected and revered by the townspeople. She is also favored by the gods because of her piety and deep respect toward them and their laws.

Creon cannot fit this image of hero. He is revered by no one and after his edict, loses all respect. A hero in this sense cannot come back from that, only a tragic hero can. Creon created the conflict that led to Antigone's ultimate downfall. This is why the distinction between hero and tragic hero is so important. Each has completely separate definitions and when, in use, can name separate people as the hero of a play. If we were

to name the hero of *Antigone*, it would be Antigone herself. She sacrificed herself for what she believed to be right. She stood up for her beliefs and represented the pious thing to do. However, this is about the tragic hero of *Antigone* and it can never be the title character herself. Creon makes a full transition in this play from hopeless villain to a character who can be forgiven and understood. Ultimately, Creon accepted his flaws and mistakes and changed who he is so that those same actions are never to be repeated. Creon learned a lesson and changed ways into a respectable man. This is the true identity of a tragic hero, *Antigone's* tragic hero.

Aristotle says a tragic hero is basically a man who has a hamartia, makes many mistakes but, in the end, learns from them and makes a change. Creon does exactly do that. His edict was his major mistake, as was enforcing it and killing Antigone. After he hears of his future, though, he tries to undo his wrongs and fails but still learns that he was entirely askew in his actions and chooses to embrace the Greek paradigm and his real destiny. Creon learns he must live revering the gods and be wise. After all, "wisdom is the supreme part of happiness; and reverence toward the Gods must be inviolate" (Sophocles, line 1348-1349).

Creon now accepts this as truth. He knows he can never achieve true happiness again without having wisdom, which only comes from piety. Creon is the perfect tragic hero. The last page ensures his emotional turmoil and new beginning is empathized by the reader. That is the true effect of a tragic hero. Tragic heroes start off disliked and their one redeeming quality saves them and allows them to be honored by the play's finale. They reach atonement for their grievances. Although this play's title is *Antigone*, it's main character that conveys all of the play's complexity, turmoil, and teaches the greatest lesson is King Creon. He epitomizes the full meaning of tragic hero as explained by Aristotle in his work *Poetics* and the Greek paradigm.

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Traduction ou Réécriture?
de *L'Empreinte de l'ange* à *The Mark of the Angel*

Caroline Mauduy[1,2]

Canadian-born novelist and essayist Nancy Huston has been both praised and criticized for her "voluntary exile" to France. Born in Calgary, Alberta, in 1953, her family moved to the United States when she was an adolescent. As a student at Sarah Lawrence University, she took part in a study abroad exchange program in France that would change the course of her life. When Huston arrived in Paris in 1973, she was fascinated by the country's intellectual energy and decided to make France her permanent home. Huston studied Linguistics under the mentorship of French philosopher Roland Barthes, but eventually she turned to writing novels. Despite being a native-speaker of English, she felt a natural inclination towards French and began to publish in her adopted language. As her success as a novelist grew, Huston decided to self-translate her works into English. This paper examines Huston's complex cultural and linguistic identity and looks closely at her unique approach to the self-translation of her acclaimed novel *L'empreinte de l'ange (*1988), translated into English ten years later as *The Mark of the Angel* (1998).

> « Le traducteur est à l'opposé du glossateur en ce sens qu'il doit fuir comme la peste le désir d'objectivité, voire le souci de comprendre rationnellement le texte auquel il veut s'affronter. D'ailleurs son rôle n'est jamais de l'éclairer, encore moins de l'expliquer (…) Je crois véritablement que le traducteur (…) doit taire sa capacité intellectuelle, ou du moins mettre en sourdine cette activité, s'il veut sauvegarder l'intuition, car il lui faut parvenir à la subjectivité. Il doit, n'est-ce pas ? Entrer

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dans l'autre, s'introduire non seulement dans son monde (…)
mais aussi s'immiscer dans son langage. »

Albert Bensoussan, romancier, traducteur

Si Nancy Huston est née au Canada et a pour langue maternelle l'anglais, elle a passé plus de la moitié de sa vie en France et écrit originellement dans sa langue d'adoption, le français. « Born in the Anglophone Canadian province of Alberta, Huston traveled to Paris for a year abroad, stayed, and made a name for herself as a French author, and later an English author. » (Shread 56) Sans cesse en train de se questionner sur son appartenance à une culture ou à une autre, elle a très vite adopté le français comme langue de référence et a ainsi publié ses premières versions en français. Mais peut-on se détacher si aisément de sa langue maternelle ? Peut-on aussi facilement manifester ses idées et ses émotions dans une langue d'emprunt que dans la langue avec laquelle nous avons grandi ?

« Tout se passe comme si elle avait besoin des deux langues, étrangement familières à la fois, pour exprimer sa double appartenance. » (El Nossery 394) Ayant refusé dans un premier temps d'écrire dans sa langue maternelle, Nancy Huston s'est décidée à traduire ses œuvres une dizaine d'années plus tard et a commencé également à publier en anglais. Ce changement de décision semble dû à un besoin d'exprimer plus précisément ses sentiments et d'avoir accès à ses vraies émotions, que ce soit dans une langue ou dans l'autre, afin de les faire ressortir plus exactement dans ses publications. « Chaque langue, en dépit de sa richesse et de ses soubassements inépuisables, est incapable de décrire l'émotion exacte ou la couleur précise. » (El Nossery 394) Nancy Huston, tout comme la plupart des auteurs bilingues ressent ce besoin d'écrire dans ses deux langues, lui permettant ainsi de laisser sortir les émotions qui proviennent de la Nancy Huston francophone ou de la Nancy Huston anglophone et de les retranscrire dans la bonne langue. Mais écrire en français apparait non seulement comme un désir sinon comme un besoin. En se tournant vers une langue étrangère pour écrire, Nancy Huston semble prouver que parfois on peut plus facilement s'exprimer dans une autre langue, ce qui peut être dû à une meilleure connaissance du vocabulaire plus formel et à une meilleure maitrise de la grammaire fraichement apprise et fréquemment révisée. Chaque phrase doit être vérifiée plusieurs fois et les tournures de phrases questionnées pour arriver à un résultat correspondant parfaitement à la pensée de l'auteur, ce qui ne serait pas forcément le cas dans la langue maternelle qui implique, elle, une écriture plus spontanée. « Unlike Beckett, who started writing in his native English and later shifted to French, for the first ten years Huston wrote only in French, apparently turning her back

on her mother tongue, English. » (Shread 56) Cependant on peut constater que le besoin de retourner aux origines se fait ressentir au bout d'un certain temps ; ce phénomène est probablement dû à la concrétisation d'une maitrise équivalente dans les deux langues. « L'acquisition d'une deuxième langue annule le caractère « naturel » de la langue d'origine – et à partir de là, plus rien n'est donné d'office, ni dans l'une ni dans l'autre. » (Klein-Lataud 105) Le bilinguisme, qui parait au début être un atout, s'avère rapidement être un obstacle à l'expression de ses ressentis, l'auteur est divisé entre deux langues auxquelles il s'identifie et à travers lesquelles il a l'habitude de formuler ses pensées, et rien ne l'empêche de mélanger ces langues lorsqu'il veut s'exprimer oralement, contrairement à l'écriture qui requiert une cohérence pour que le lecteur puisse comprendre.

Alors virtuose dans les deux langues, Nancy Huston ne peut plus profiter de l'avantage d'un meilleur rapport grammatical dans l'une des deux langues et il parait plus simple et plus judicieux de laisser sa créativité s'exprimer à travers sa langue maternelle afin de mieux retranscrire ses pensées. « Les textes de Huston sont […] la transcription du flot de conscience émanant d'un esprit qui n'est totalement investi ni par l'anglais ni par le français » (Danby 83) Mais au final, Nancy Huston aura trouvé comment pallier, plus ou moins, les carences rencontrées dans chacune des deux langues.

Traduttore, traditore ?

En 1998, Nancy Huston publie *L'Empreinte de l'ange* qu'elle traduira et publiera sous le nom de *The Mark of the Angel* en 1999. Bien que publiée seulement un an après la parution de l'original, cette traduction soulève de nombreuses questions. En comparant les deux versions du roman, on peut constater que Nancy Huston a respecté la plupart des procédés de traductions. En effet, grâce à sa connaissance des deux cultures, francophone et anglophone, elle s'est appliquée à effectuer les adaptations culturelles, procédés de traduction consistants à remplacer une réalité socioculturelle du texte source par une autre, propre à la socio culture du texte d'arrivée, permettant ainsi au lecteur de comprendre la totalité du roman. « En traduisant ses propres œuvres, Nancy Huston les fait croitre (selon l'étymologie du mot *auctor*) en les amplifiant, dans un geste qui fait doublement acte d'autorité. » (Wilhelm 9) On trouve ainsi « Sa mère ne disait ni les Bosches ni les Chleuhs ni les Fridolins » (Huston 16) transposé en « His mother called them neither Krauts nor Bosches nor Jerries » (Huston 8), ou encore « *Un* parapluie ? Non, c'est pas vrai ! Un objet si tellement comme une femme ! *Une* parapluie, moi je dis ! » (Huston 209-10) traduit par « It is masculine, umbrella ? No, I don't believe it! A

so-feminine object! For me it's feminine! » (Huston 211) Dans ces deux exemples, Nancy Huston a pensé aux lecteurs anglophones et a adapté sa traduction afin qu'ils puissent comprendre chaque nuance et subtilité présentes à l'origine dans le texte source, que ce soit au niveau du vocabulaire comme de la grammaire pure qui distingue en français le masculin du féminin.

Cependant, elle a pu aussi se permettre certaines libertés qu'un traducteur professionnel n'aurait pas pu prendre. « One of the distinctive characteristics of self-translation is its daring ability to take liberties that would be unacceptable to anyone but the "author" of the work. These so-called "infidelities" are allowed so long as they are carefully delimited by the authorizations of self-translators. » (Shread 59) L'omission, faute de traduction consistant à ne pas traduire- sans que cela soit justifié- un élément de sens du texte source, est une erreur à éviter absolument puisqu'elle dénature et « sous-traduit » le texte d'origine. Si on trouve « Tu es fou. Une bonniche…tout de même » (Huston 22) dans le texte source, la traduction devient « You must be crazy. A maid… of all things. » (Huston 14) Dans la version française, le mot « bonniche » véhicule une image très négative et a une connotation péjorative insinuant que la bonne à tout faire n'est ni respectable ni à respecter, alors que dans la version anglaise, le mot « maid » fait seulement référence à la profession de Saffie et n'évoque rien de négatif voire péjoratif. Il est vrai qu'il n'existe pas de terme précis pour traduire exactement « bonniche » cependant il aurait fallu, pour rester fidèle au texte, ajouter un adjectif qualificatif, par exemple « lowly, » ou encore tirer vers l'exagération en traduisant par « servant » afin de garder ce sens péjoratif. On trouve également « Un vieux blague. Très vieux » (Huston 119) traduit par « An old joke. Very old. » (Huston 113) Ici pareillement, on a affaire à une omission, puisque dans le texte source, Andràs fait une faute de français alors que dans le texte d'arrivée la phrase est parfaitement correcte. Dans ce cas-là, retranscrire cette erreur portant sur le genre, qui n'existe pas en anglais, relève du défi mais n'est pas impossible. Elle aurait pu porter la faute sur l'article au lieu du nom, « A old joke, » mais elle a fait le choix de ne pas le traduire.

« Aussi la question de l'infidélité, illustrée par l'adage *traduttore traditore,* se trouve-t-elle être réfutée par Nancy Huston, à la fois dans sa pratique de l'auto-traduction et dans un texte intitulé *Traduttore non è traditore.* » (Wilhelm 3) En traduisant elle-même ses ouvrages et en oubliant volontairement de traduire certaines nuances ou encore en n'employant pas forcément le mot juste, Nancy Huston prouve que le traducteur n'est pas un traitre mais qu'il fait seulement des choix pour que le texte d'arrivée reflète au mieux le texte source, quitte à laisser de coté certaines nuances qui ne sont pas d'une

importance capitale mais qui, en étant traduites coûte que coûte, pourraient alourdir le texte ou casser le rythme créé par l'auteur dans le texte d'origine.

De l'auto-traduction à la réécriture

A la différence d'une traduction, une réécriture est la reprise d'un texte en améliorant sa forme ou en l'adaptant à une nouvelle destination. « La traduction pourrait être considérée comme une œuvre originale ou mieux une traduction originale, puisqu'il s'agirait plutôt d'une réécriture ou d'une création parallèle et non pas d'une traduction au sens traditionnel du terme. » (El Nossery 394) Dans cet article, l'auteur attire l'attention sur la frontière entre l'auto-traduction et la réécriture. A quel moment pouvons-nous décider qu'une auto-traduction devient une réécriture ?

Même si seulement un an s'est écoulé entre la publication des deux versions, il est difficile de ne pas se demander comment sa façon de pensée et de l'effet que cela pourrait avoir sur la traduction de son livre vont évoluer. Car si un livre peut être traduit une dizaine d'années plus tard sans que la question de la réécriture ne se pose, c'est parce qu'un traducteur professionnel est impliqué. Il découvre l'œuvre pour la première fois et travail alors seulement avec de la matière, avec des mots bruts, il ne manipule pas une pensée qui aura eu le temps de changer, d'évoluer. On peut alors s'interroger sur certains choix de traduction de Nancy Huston. « During the self-translation process she revisits and edits the original, and in this way, changes the original when necessary, which was the process she used in recreating Plainsong and *Cantique des plaines* equally in French and in English. » (Danby 85)

Reprenons « bonniche » qui a été traduit par « maid, » était-ce un choix délibéré de ne pas alourdir le texte en étoffant le nom, ou a-t-elle choisit de le traduire de cette façon afin de nuancer son propos ? Si la réponse n'est pas évidente sur cet exemple, un extrait de l'épilogue montre que Nancy Huston aurait bien pu reconsidérer son roman. Dans la première version, Nancy Huston écrit « Paris est Paris, plus insolent que jamais dans sa beauté et ses gouts de luxe. » (Huston 217) Dans la version anglaise, cette phrase devient « Paris is Paris, more insolently gorgeous and in love with luxury than ever, » (Huston 220) et si le sens général reste le même, on s'aperçoit tout de même que la version anglaise est plus douce, moins agressive que la version française. « Insolent, » complément d'objet direct de Paris dans le texte d'origine se transforme en « insolently, » adverbe faisant référence aux compléments du nom dans la traduction. Ce changement de catégorie grammaticale atténue le sens de la phrase. Nancy Huston, après avoir laissé son œuvre au repos un an, a pu changer son point de vue sur le monde, sa perspective de la

vie à Paris, et cette animosité que l'on peut parfois ressentir dans la version française disparait dans la version anglaise. De même lorsque Raphaël pose une question à Emil à laquelle il ne peut répondre que par oui ou par non, « Tu es d'accord que c'est moi et pas l'autre ? » (Huston 213) dans la version originale, prend une toute autre tournure dans la version anglaise, où il lui demande clairement de faire un choix, « Who did you say your papa was ? Me or him? » (Huston 215) Les attentes et les intentions de Raphaël sont différentes dans les deux versions. Dans cet exemple, la version anglaise apparait plus violente et controversée que la version originelle et implique une différence de caractère et des réactions différentes chez Raphaël.

Dans son article, Carolyn Shread fait remarquer que la traduction de *L'Empreinte de l'ange* avait fait polémique. En effet, « In 1998, her novel, *L'Empreinte de l'ange*, was nominated for the French-language Governor General's Prize and for the translation prize, but the following year, the Canadian Arts Council refused to consider *The Mark of the Angel* for the English-language award, on the grounds that it was "une version réécrite en anglais". » (Shread 58) La frontière entre auto-traduction et réécriture est très difficile à discerner et un même texte peut être considéré comme étant une traduction pour une personne et comme une réécriture pour une autre. Mais que ce soit l'auto-traduction ou la réécriture, les deux font partie du monde littéraire qui ne peut être objectif et sera donc toujours sujet à discussions.

Nancy Huston défend par le biais d'une lettre que « *Cantique des plaintes* n'est pas qu'une simple traduction de *Plainsong* ; c'est une deuxième version originelle du même livre. » (Shread 58) Elle déclare elle-même que son livre n'est pas une simple auto-traduction, mais une réécriture de la version originale ce qui laisse à penser que ce fut également le cas pour *L'Empreinte de l'ange.* On pourrait ajouter à cela que ce besoin de modifier les versions originales lors du processus de traduction est lié à son bilinguisme et sa bi-culturalité. « L'auto-traduction dans les deux sens, chez Nancy Huston, vient subvertir les rapports de dépendance hiérarchique entre l'original et la traduction, ou l'opposition entre langue maternelle et étrangère, nous invitant ainsi à nous interroger sur nos pratiques et nos représentations de l'écriture et de la traduction. » (Wilhelm 2) Nancy Huston doit ressentir comme un besoin d'exprimer dans ses deux langues ce qu'elle ressent et ce qu'elle veut partager avec son lectorat, cependant, consciente des différences culturelles ce sera la Nancy Huston francophone ou la Nancy Huston anglophone qui écrira, d'où les divergences entre les deux versions.

S'il parait évident que le bilinguisme peut être un avantage, il est bien plus rare de se rendre compte que cela peut aussi impliquer des problèmes tels que la recherche

d'identité ; Nancy Huston a exprimé ce sentiment de désorientation dans son livre intitulé *Nord Perdu.* On n'aurait cependant pas imaginé que ce sentiment de non appartenance à une culture particulière puisse la mener à se faire rejeter par la communauté québécoise, « Taking a protectionist stance, the Quebecois community claimed that Huston could not be considered for a Francophone literary prize since she is a native English speaker. They asserted that any "French" novel of hers had in fact to be a translation from English. » (Shread 57) Bien qu'elle ait écrit ses romans en français dans un premier temps, puis qu'elle les ait traduits en anglais dans un second, il semblerait que ne pas écrire dans sa langue maternelle puisse être considéré comme une traduction instantanée au sein même du processus d'écriture. Pouvons-nous alors considérer la version anglaise issue de la traduction comme une version originale ?

« Je revendique le fait d'être l'auteur des deux versions, c'est tout, » (Shread 58) a déclaré Nancy Huston. L'auto-traduction est un moyen de s'exprimer pleinement sans avoir à passer par une tierce personne, et qui autorise des libertés que les traducteurs n'ont pas. Et même s'il est possible que le texte original soit altéré au cours de la traduction, cette dernière n'en ressortira que meilleure pour le lecteur du texte d'arrivée qui pourra mieux s'identifier au texte et le comprendre. Au final, l'auto-traduction semble être un terme définissant la manipulation dans une langue B, d'un texte écrit dans une langue A, permettant à l'auteur de continuer son processus de création dans une des langues qu'il maitrise et offrant au lectorat une seconde version originelle complètement adaptée à sa langue.

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Women's Liberation: Beauvoir and Wollstonecraft's Theories Pre-Figured in the Life of Sor Juana Inés de la Cruz

James Alicea (Government & Politics)[1]

Although she lived in a time period long before the official advent of the feminist movement in the late 19th Century, Sor Juana Inés de la Cruz's acts of female resistance against patriarchal and ecclesiastical dominance exhibit several proto-feminist qualities that would later become the basis of modern feminist thought. As a nun who was confined to a life of servitude and submissiveness to male authority, Sor Juana's ability to transcend in society was non-existent. In order to break away from her oppression as a female Church figure, Sor Juana engaged in highly controversial acts of intellectual dissent, such as keeping an expansive library to become literate and to educate herself, and using scripture passages to argue against the actions of ecclesiastical figures who condemned the role of women in religion and politics. Sor Juana's greatest moment of dissent is present in her work, *La Respuesta a Sor Filotea,* in which she responds to a letter of censure by the Bishop of Puebla, stating "I entered the religious order, knowing that the life there entailed certain conditions, most repugnant to my nature; but given the total antipathy I felt for marriage, I deemed convent life the least unsuitable and the most honorable I could elect if I were to insure my salvation" (Scott 511). Ultimately, through her use of religious scripture to justify women's right to an education and to a life of intellectual fulfillment, Sor Juana's *La Respuesta a Sor Filotea* signifies one of the first acts of proto-feminism, and exemplifies the two main arguments for the liberation of women present in Mary Wollstonecraft's *A Vindication for the Rights of Woman* and Simone de Beauvoir's *The Second Sex.*

During the time when Sor Juana was alive, 17th-century Mexico was a colony of Spain called *La Nueva España* (New Spain) and it was a part of the *Nuevo Mundo* (New World) (Edsitement 1). The time period was referred to as *La Colonia,* which started when the Aztec Empire was defeated by the Spanish Conquistadores led by Hernán Cortés on August 13, 1521, and ended when Mexico obtained its Independence in 1821 (Edsitement 1). During *La Colonia*, social, economic, and educational opportunities were

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determined primarily by gender, national origin, ethnicity, and social class (Edsitement 1). The most powerful individuals in society were known as the *castizos*, or children of individuals born in Spain (Edsitement 1). Beneath the *castizos* on the social hierarchy were the *criollos*, or people of white, Spanish blood, but born in the New World (Edsitement 1). Sor Juana Inés de la Cruz was a *criolla*, which allowed her the privilege of access to limited education, to the Viceregal Court, and to contact with the educated elite (Edsitement 1). Most importantly, Sor Juana's status as a *criolla* was the reason she was able to enter a convent, where she was able to nurture her talent and knowledge; only *criollas* and *castizas* could become nuns in New Spain, as service to God was considered a privilege reserved for only the social elite (Edsitement 1).

While Sor Juana's heritage enabled her to enter the convent, her female gender would ultimately serve as a barrier to her intellectual enlightenment. Because education and knowledge during *La Colonia* were entirely reserved for men, the education women could receive was significantly inferior to the education men received (Edsitement 2). Furthermore, women were not allowed to pursue higher studies, such as the philosophical theories of Aristotle and Plato, or the work of great mathematicians like Pythagoras (Edsitement 2). Sor Juana, as a dedicated intellectual and a figure of proto-Enlightenment thought, was determined to rebel against this rule, and began learning Latin at a very young age (Edsitement 2). Before the age of fourteen, Sor Juana wrote her first poem. Knowing that women were not allowed to attend the university in Mexico City, she made the best of an isolated, self-directed schooling; she eagerly read through countless books initially in Panoayan where the family farm was located, then at court in Mexico City (Edsitement 2). As Electa Arenal and Amanda Powell state in their article, "A Life Without And Within: Juana Ramirez/Sor Juana Ines De La Cruz:"

> Sor Juana's prodigious talent, furthered by intense efforts that began in early childhood, produced a serious intellectual while she was still in her teens. She taught herself the forms of classical rhetoric and the language of law, theology, and literature. At every turn, from her courtly and learned yet marginalized standpoint, she contradicted - or deconstructed – artistic, intellectual, and religious views that would refuse her and others like her the right to express themselves (Arenal 67-68).

In time, Sor Juana realized that she would be unable to obtain the texts she required to pursue her quest for intellectual liberation outside of the Church. She subsequently joined the Order of San Jerónimo, taking her vows and entering the Convent of Santa Paula in 1669, despite her opposition to its policies that treated women

as property and as servants of men (Edsitement 2). Therefore, Sor Juana did not choose to become a nun and enter the convent solely for religious purposes—she used the power and wealth of the Church as a means to obtain the knowledge she required to expedite her path to intellectual freedom.

Once situated in the convent, Sor Juana displayed her first overt actions of proto-feminism. She began by amassing her own library, which would later become one of the largest in the New World, to pursue her own writing and education (Edsitement 2). What made Sor Juana's education "proto-feminist" was not only the fact that she was rebelling as a woman prohibited from higher study, but also the way in which she educated herself. Sor Juana, as an autodidact, proved to the individuals in the New World that women were capable of comprehending material without it being presented to them in a simplified form by a male instructor. As Arenal and Powell state, "Respect for exceptionality was in part a reflection of the profound seventeenth-century interest in unusual natural phenomena that viewed artistic talent and intellectual drive in human females as fascinating abnormalities. Sor Juana learned to exploit the fact that she was cataloged as a prodigy; she both defended and derided the hyperbolic terms of praise her exceptionality attracted" (Arenal and Powell 68). Thus, in a true proto-feminist fashion, Sor Juana literally used her womanhood to attain more knowledge—an action that would be regarded by modern day feminists as a brilliant strategy for female enlightenment in an environment of ubiquitous male domination.

Furthermore, Sor Juana was also strategic about what she wrote. She was aware that successful writing would garner her acclaim, and therefore, access to more materials from which to study and write. Thus, many of Sor Juana's early writings were primarily of Baroque or love poetry, topics for which she held little passion, but which she executed artfully in order to maintain her popularity in the literary cannon and subtly avoid being persecuted for her private higher intellectual studies (*I, The Worst of All)*. As Arenal and Powell argue, "The stratagems Sor Juana evolved for artistic and intellectual survival were so subtle that, given the continuity and pervasiveness of patriarchal values up to the present, the magnitude of her reinterpretations has often been missed or distorted even in our time…The ease with which she versified her [Baroque] style, and the irony with which she applied her wit gave her an enormous literary mobility" (Arenal 68). Thus, her strategy was greatly successful, as her artfully constructed poetry helped her to win the favor of the viceroy and vicereine, who would later afford her much needed protection when high ranking church officials attempted to prohibit her from her studies (*I, The Worst of All).*

Gradually, however, other factors began to weigh more heavily than viceregal support and fame in the New World. As the seventeenth century reached its last decade, Sor Juana's situation and that of New Spain changed drastically. Most notably, economic, social, and political crises spread throughout Mexico, causing many of Sor Juana's most significant supporters to return to Spain (Arenal 74). In addition, the newly appointed Archbishop of Mexico, Francisco Aguiar y Seixas, was a severe and misogynistic prelate in no way disposed to judge Sor Juana's studies favorably (Scott 514). As Nina M. Scott claims in her article, "Sor Juana Ines De La Cruz: Let Your Women Keep Silence In The Churches," Aguiar y Seixas was a "twisted Catholic puritan [who] had a pathological aversion to women…If a woman crossed his threshold, he promptly ordered all the bricks torn up and replaced upon which sacrilegious feet had trod" (Scott 514). As a result, Sor Juana's writing on both religious and mundane subjects came under more direct fire from male ecclesiastical figures, placing such valuable possessions as her library and musical instruments in jeopardy (Arenal 74). As Arenal argues, before the viceroy and vicereine left Mexico, "Many nuns wrote. Although complicit through their service to the church, not all were unthinking handmaidens to the sceptre and the cross. The very nature of a female community allowed them to develop separate voices from those of the priests and confessors who officially controlled their lives" (Arenal 72). It was this sense of female community that patriarchal leaders wished to destroy, as they understood that, when united, women would become too great a threat to the "sanctity" of exclusively male leadership.

The pressures of new ecclesiastical leadership, coupled with the impending loss of her ability to study and write, prompted Sor Juana to begin her trademark piece of proto-feminist dissent— *La Respuesta a Sor Filotea.* Written in March of 1691 as a response to a critique by the Bishop of Puebla, Sor Juana used *La Respuesta* to defend her right to devote her time to secular and artistic endeavors, such as the production of love poems and dramatic pieces, as well as her right to study and develop intellectual pursuits as a woman in New Spain (Sor Juana 1). In the section of her letter entitled "*Narratio,"* Sor Juana puts forth several compelling arguments to defend her acts of higher self-education. First, she asserts that in order to study and fully understand scripture and theology, one must have a substantial understanding of logic, physics, rhetoric, music, math, architecture, history, law, Patristic commentary, and astronomy (Sor Juana 1). She claimed that all subjects are interrelated because God has designed it so. Secondly, she asserts that it is in human nature to "abhor [the] one who excels," arguing that Christ was abhorred for his divine beauty as the God-man and for his

miracle-working (Sor Juana 1). Lastly, she asserts that “Riches and power strike at reason, for few will allow that someone else is better” (Sor Juana 1). She states, “I do not study to write, not less to teach (that pride was in me excessive), but only for seeing if in spite of studying I ignore less. This way I answer it and this way I feel it” (Sor Juana 1). Sor Juana’s *Narratio* artfully presents facts that will later support her argument for the empowerment of women in the *Confirmatio* and *Refutatio* sections.

Confirmatio and *Refutatio* are the heart of Sor Juana’s stance as a proto-feminist figure. In the first paragraph, she recounts several Hebrew and Greco-Roman female scholars and leaders, who, she asserts, were integral to the understanding of current Scriptural and general knowledge (Sor Juana 2). She then addresses the patriarchal belief that women should not study and interpret scripture publicly in a pulpit or university setting (Sor Juana 2). She justifies her objection on the grounds that those who are able, both men and women, should be allowed to do so (Sor Juana 2). Therefore, in Sor Juana’s view, the claim that "study is harmful" is a stance undertaken by only the half-informed and foolish; she instead asserts that humans “should know the measure of our abilities” (Sor Juana 2). In addition, she proposes that just as Jerome believed his daughter Leta should be educated, his spiritual daughters, the nuns, should be educated as well (Sor Juana 2). This observation leads Sor Juana to conclude that older women should teach younger women and thus keep them safe from ignorance as well as the temptations of male tutors (Sor Juana 2). Finally, Sor Juana concludes by deconstructing the misinterpretation of the Biblical line in Timothy 2:11, "Let the woman learn in silence" (Sor Juana 2). She claims that no matter how the line is interpreted, no interpretation precludes women from engaging in private study (Sor Juana 2). Such language, given the severity of the patriarchal ecclesiastical order, is unquestionably a convincing advocacy for the equal treatment of women in education—a foundation of the modern feminist cause.

The themes of women’s historical triumph and the liberation of the female mind that Sor Juana presents in *La Respuesta* share many similarities to the argument that Mary Wollstonecraft puts forth in her text, *A Vindication of the Rights of Woman.* According to feminist scholar Breny Mendoza, Wollstonecraft's primary concern with the non-recognition of reason in women was mediated by her concern with the relationship of women and the divine (Mendoza 287). For Wollstonecraft, robbing women of the right to exercise reason—a precious good that separated men from women— prevented women access to God, which was “indispensable to the eternity of their souls” (Mendoza 287). Moreover, Wollstonecraft argued that because the human spirit had no gender and

humanity was crafted in the image of God, there was no basis for the subordination of women on Earth (Mendoza 287). Thus, it is clear that both Wollstonecraft and Sor Juana believed that men could not act as the mediator between women and God—the first step in the natural liberation of women.

Furthermore, Wollstonecraft's justification for the education of women in her text is parallel to Sor Juana's justification for her self-education in *La Respuesta.* In her text, Wollstonecraft states that without turning into rational beings through education, women were not only at the mercy of men's laws, but were also denied the necessary knowledge to save their souls (Mendoza 287). Therefore, just as Sor Juana argued, Wollstonecraft asserted women's higher education was not a contrived plot to overthrow male superiority, but rather, a vehicle to spiritual emancipation. In her insistence on the genderless nature of the soul and intellect, Wollstonecraft writes, "My body, disinclined to this man or that, serves only to house the soul…you might call it neuter or abstract" (Wollstonecraft 47). Wollstonecraft's quote mirrors Sor Juana's dispute in which she breaks relations with her confessor, and in which she repudiates the mediation of a man between God and herself. As Mendoza points out, "Sor Juana claims [to her confessor] that her exercise of God's gifts—her intellect—is already her key to heaven. [For Sor Juana,] intellectual talents were God's way of giving individuals free will and the opportunity to grow in virtue" (Mendoza 288).

Wollstonecraft and Sor Juana's strongest parallel is in an area essential to the feminist cause—the unification and cooperation of women to achieve liberation as a whole. In the beginning of her text, Wollstonecraft states, "I do not wish them [women] to have power over men, but over themselves" (Wollstonecraft 10). This quote shares a powerful connection to the life of Sor Juana; as a woman who sacrificed all of her freedom to join a convent, merely to attain a chance to educate herself, Sor Juana passionately believed that women should have the right to govern their bodies and their minds. Wollstonecraft's famous quote also connotes a sense of a necessary camaraderie of women, which is symbolically depicted in *I, The Worst of All* through Sor Juana's passionate relationship with the vicereine. In her *Vindication of the Rights of Woman,* Wollstonecraft also states, "Taught from their infancy that beauty is woman's sceptre, the mind shapes itself to the body, and roaming round its gilt cage, only seeks to adorn its prison" (Wollstonecraft 33). The use of the prison metaphor becomes a grotesque reality in the life of Sor Juana, who in *I, The Worst of All* is frequently depicted behind bars, struggling to free not her body, but her mind from the "cages" of patriarchal domination. Thus, for Sor Juana and Wollstonecraft, intellectual liberation is essential not only to

liberate women, but also to bring them together to ensure their united effort against female subjugation.

Sor Juana's *La Respuesta* also presents gender ambiguity as a major component in the goal for women to attain freedom—a proto-feminist idea that would later be developed and highly publicized in Simone de Beauvoir's cornerstone text, *The Second Sex.* In her text, Beauvoir poses the legendary question, "What is a Woman?" in response to the centuries of female subjugation and degradation, particularly in the realm of social mobility (Beauvoir 10). Beauvoir ultimately argues that women may not truly, by definition, exist in the world; in reality, Beauvoir claims that there are too sexes: male and the "Other" (Beauvoir 14). Beauvoir attributes this lack of female identity in the world to a status that she calls the "Eternal Feminine," a status that men, and often women themselves, use to force women into a role of life-long "immanence" (Beauvoir 21). Beauvoir states, "Hence woman makes no claim for herself as subject because she lacks the concrete means, because she senses the necessary link connecting her to man without posing its reciprocity, and because she often derives satisfaction from her role as Other (Beauvoir 10)." When locked in a state of immanence, women are forced to live only for others, and forfeit (through coercion or voluntarily) their ability to transcend in society and achieve significant and impactful goals (Beauvoir 21).

Beauvoir concludes her renowned feminist text by asserting that women need to claim an identity in society in order to break free from the "Eternal Feminine," or they risk the perpetuation of a cycle of female exploitation for all future societies (Beauvoir 23). Beauvoir states "If I want to define myself, I first have to say 'I am a woman;' all other assertions will arise from this basic truth. A man never begins by posting himself as an individual of a certain sex: that he is a man is obvious…the relation of the two sexes in not that of two electrical poles: the man represents both the positive and the neuter…[while] woman is the negative, to such a point that any determination is imputed to her as a limitation, without reciprocity" (Beauvoir 5). Moreover, Beauvoir stresses the fact that women must bring about the change on their own, as patriarchal society will never surrender itself to the will of a single oppressed woman. As Beauvoir states, "In truth, nature is no more an immutable given than is historical reality. If woman discovers herself as the inessential and never turns into the essential, it is because she does not bring about this transformation herself (Beauvoir 8)." Thus, women must unite and reject the "fixed identity" of the Eternal Feminine, fulfill the role they wish to fulfill in society, and ultimately reclaim their subjectivity and ability to transcend in their own lives.

It is clear that Sor Juana had been one of the first women to understand the dangers of submitting to the "Eternal Feminine." For Sor Juana, gender was irrelevant to one's potential, and she often recognized the literary accomplishments of both men and women equally, not taking gender into consideration. She also believed that both men and women were equal before God, and thus, the road to intellectual liberation was not paved exclusively for the feet of men (*I, The Worst of All)*. Sor Juana's stance on gender resonates with Beauvoir's "solution" to sexual discrimination, which she refers to as the "Ethics of Ambiguity." According to Beauvoir, when one embraces the "Ethics of Ambiguity," one is truly free to acknowledge oneself and others as both subjects and objects (Beauvoir 54). Thus, both men and women would have the freedom to act actively and passively, eliminating the exploitative patriarchal system which forces both sexes into roles based on stereotypes and gender-biased laws. If members of the ecclesiastical order had followed Sor Juana's embracement of gender ambiguity in her age, she would have been able to continue writing and studying, producing works of intellectual genius, and would never have been forced to construct a humiliating recant letter proclaiming that she was the worst in the world (*I, The Worst of All*).

Even though Sor Juana's "proto-feminist" statements and works are generally regarded extremely subtle, there is no question that, in the presence of an overbearing threat of censure from the Church, Sor Juana radically challenged gender and patriarchal norms throughout her lifetime. Her arguments presented in *La Respuesta,* such as the necessity of gender ambiguity and the communion of women, are essential to modern feminist political and social thought. Her acts as a dissident and a martyr in an oppressive regime have also motivated other feminist women to make similar sacrifices for their beliefs, as demonstrated by noteworthy feminists Emma Goldman, Susan B. Anthony, and Kate Chopin. Although Sor Juana's life and work of genius were cut short by the pressures of the Church and the plague that struck Mexico in the late 17th century, she set the precedent that it was both feasible and influential for women to rebel against patriarchal norms through writing and speech. This brave and passionate risk would ultimately evolve into one of the greatest civil rights movements in the history of human existence—the global unification of women and the several waves of feminism adopted to achieve female economic, political, and social equality.

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The Conflicted Metaphysical State of Humanity in Book I, Canto 7 of *The Faerie Queene*

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In *The Faerie Queene*, Edmund Spenser depicts allegories that potently convey the conflicted metaphysical state of humanity. His characters and the adventures they undertake emit the elements of the constant conflict between good and evil. As Redcrosse travels along his perilous path, he projects the image of the Christian soul on its physical journey. In Book I, Canto 7, Spenser reveals Redcrosse's spiritual drama in full detail. As the condition of being human is a state of imperfection, Redcrosse's adventures convey the constant conflict the human experiences between good and evil.

Spenser sets the teachings of dry doctrine to the tune of a vibrant narrative. A great deal of Scripture, especially the epistles of St. Paul, deals with the struggles of the human experience and confrontation with sin. Spenser's dramatization of these teachings conveys that these lessons can be potently understood by living through them. As Redcrosse's adventures depict the Christian's journey through life, his experiences provide readers with a highly relatable narrative interpretation of Christian doctrine.

The protagonist of Book I is Redcrosse, the character representation of the individual human on his quest for holiness. Since Redcrosse is human, he is tainted by the effects of Original Sin. According to Elizabeth Heale, *The Faerie Queene* conveys Spenser's "Protestant pessimism about the ultimate falleness of the human condition and the inevitable failure of human virtue" (15). Humans are imperfect creatures. They have the capacity to accomplish virtuous acts, yet they are also susceptible to the temptations of sin. The Fall of Man resulted in "the consequent corruption of man's nature" (Heale 20). Therefore, Redcrosse's human status has the element of imperfection woven into its composition. He constantly finds himself as the center of the battleground, in which the forces of evil wages their heated war with the forces of good. Redcrosse constantly feels this tension, leaving him with a critical choice: Which side will he support? Spenser employs Redcrosse's encounter with Duessa as well as his consequent confrontation with Orgoglio to depict the conflicted nature of the human experience.

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After Redcrosse's previous battle, Spenser portrays him as "sweatie" (20) and "wearie" (15). His body is reeling from the peril of battle. Spenser emphasizes the human body to convey this inherent weakness. The flesh betrays us with a state of frail imperfection, and these bodies are like physical representations of our state of imperfection. Spenser is depicting the way in which our bodies hold us back, hampering our attempt at a continuous forward motion. In Canto 7, Redcrosse pauses during his journey in order to "rest him selfe" (16). After sitting down near a fountain, he "disarme[s] all of his yron-coated Plate" (17). Spenser's writing is characteristically stratified into multiple aspects. On the surface, the removal of this knight's protective armor conveys he is open to a physical attack. However, on the metaphysical level, the armor is also representative of the sanctifying grace that comes from God. "The overall emphasis of the armor of God in *The Faerie Queene* manifests joyous triumph over the forces of darkness and chaos" (Hamilton 62). Humans need this to protect our frail human selves. Grace lifts us up when the incompetent nature of our human selves disappoints us.

As Redcrosse removes his armor, he is letting his guard down. In the Bible, Ephesians 6:13 compels Christians, "Therefore put on the full armor of God, so that when the day of evil comes, you may be able to stand your ground, and after you have done everything, to stand." Romans 13:12 urges Christians to "put on the armor of light." Humans need to wear this covering in order to protect themselves from evil. Otherwise, our bodies—imperfect and vulnerable-- are exposed to the temptations around us. As John Calvin emphasizes that humans are careless with the graces God extends to us. He says, "We are commonly like soldiers who are about to meet the enemy, yet foolishly remove their armor" (Hamilton 62). Spenser has Redcrosse exactly exhibits this behavior right before he meets Duessa.

Redcrosse's tired human body seeks relief from the conditions under which it is becoming sluggish, much like a burden. As a result, Redcrosse longs for a pause in his action. He yearns to take a break from his journey and rest where he can be "shielded" (30) from the "boyling heat'/" (30). As a result, he opens the way to the vice of lust. He "bathe[s] in pleasurance of the joyous shade,/" (29). He is like stagnant water, relaxing aimlessly. According to the Bible, God is outraged by sloth. Revelations 3:16 reads, "So then because thou art lukewarm, and neither cold nor hot, I will spew thee out of my mouth." If someone is living a life that is devoid of fervor for actively carrying out the duties of God's callings, they are being sinfully rebellious against Him.

The sloth mentality Redcrosse displays while resting makes him more susceptible to temptation. In this moment, Redcrosse is not in a position in which he is in control over his appetites. Spenser conveys this by painting a literary portrait of Redcrosse sitting on the ground, off his horse. “And by his side his steed the grassy forage ate./” (18). This imagery employs the symbolic nature of the horse. If Redcrosse is not riding his horse, he is exhibiting an internal absence of control of his appetites, especially lust. Jeremiah 5:8 reads, “They were fed as horses in the morning: every one neighed after his neighbor’s wife.” Like the men in this verse, Redcrosse is now vulnerable to the experience of lust. His relaxed state, as well as his position in respect to his horse, foreshadows that he will yield to his urges of his appetites rather than restrain them with the power of his logic.

The third stanza exudes a lighthearted tone that is nevertheless tainted by the forewarning of oncoming danger; Spenser utilizes his imagery to foreshadow the human’s upcoming confrontation with evil. As the Renaissance adage states, “The eyes are windows to the soul.” Spenser strives to influence not only the minds of his readers, but their souls as well. He does so through his vivid descriptions that leap off the page, blooming like a literary garden. Spenser writes scrupulously, painstakingly chiseling out his sentences until he has carved out the literary image he sought to portray.

For example, Spenser’s imagery depicts the presence of trouble within an otherwise joyful setting. As the “breathing wind” (20) flows through the air, it “gently playes” (20) amongst the “trembling leaves” (21). The choice of the verb “trembling” is emblematic of quivering. Despite the buoyant setting that radiates gently playful wind and “sweet musick” (23), the leaves are exuding an ominously fearful aura.

Just after the trembling omen, the “Witch” (24), Duessa, appears on the scene. Duessa’s attack upon Redcrosse is very subtle. She is emblematic of the falsehood and deception used to ensnare Redcrosse. She approaches him with a pleasing appeal, speaking in a tone Spenser describes as sweet: “With fowle words tempring faire, soure gall with hony sweet” (27). Nonetheless, beneath this pleasing surface is the “soure gall” of temptation and sin. This deceptively subtle method of evil is a stark contrast to Redcrosse’s previous confrontation with evil in the House of Pride. Through this contrast to the blatant, obvious display of evil in that house, Spenser is warning his readers of evil’s ability to lure the human into sinful actions by means of a subtle attack.

Evil can slyly deceive the human mind. By appearing in a form that appeals to the carnal desires of the body, evil can lead humans down its dark path. To depict this concept in his poem, Spenser zeroes in on Recrosse’s body: “And mighty strong was

turned to feeble frail" (50). Redcrosse is usually characterized as a powerful and courageous knight, yet, we now see him in a time of weakness as he loses his grip of his self-control.

Immediately after he embraces Duessa, a brutally terrifying monster makes its entrance into the poem. A "dreadfull sound" (58) penetrates the scene, while ""all the earth for terrour seemes to shake,/" (60). This frightening description sparks fear in the readers. On the surface, Spenser is instilling fear of the storyline's villain; however, on the metaphysical level, the depiction of a giant, according to Heale, is emblematic of rebellion against God (39). Redcrosse gives in to sloth and his bodily lust, and, as a result, he embraces falsehood in the form of the witch Duessa. These actions represent sinful behavior, which are starkly contradictory to God's laws. The battle with Orgoglio is a tableau of the battle between flesh and spirit.

Through Orgoglio's brutal fight with Redcrosse, Spenser conveys a message that is very similar to that of Isaiah 28:24, which states that just as farmers must break up dry soil in order to make it usable for planting. Humans must let God destroy the ills of their ways in order for us to be utilized as His instruments. Thus, punishment chastises us and thereby cleanses us. After Orgoglio incarcerates Redcrosse in the dungeon (130), Redcrosse indeed suffers and develops a sense of chastisement. This brutal awakening allows Redcrosse to open his eyes to the evils of his actions, and it sets us, the humanity he represents, back onto the right path. Spenser is conveying humanity's need to be corrected when caught in the treacherous waves of evil and its temptation.

Redcrosse's need to be chastised is inherent, resonating with humanity. John Donne expresses this yearning in "Holy Sonnet 10". The speaker turns to God, asking Him to "break, blow, burn and make new" (4). In order to become fully devoted to God's callings, the speaker believes he must submit himself to God's destruction of his old, sinful ways. *The Faerie Queene* depicts this through Redcrosse's brutal confrontation with the giant. Orgoglio is the means by which "Redcrosse's inward pride and self-conceit are broken in preparation for his regeneration" (Heale, 39). Redcrosse has been shaken both outwardly and inwardly, allowing him to recalibrate his disposition through the experience of chastisement. Although he has to withstand a brutal confrontation with a violent giant, Orgoglio, to reach this awakening, Redcrosse survives. "Redcrosse is a type of fallen man, unable by his own efforts to free himself from Duessa or escape Orgoglio's dungeon, and only finally enabled to achieve holiness and accomplish his quest through the powerful intervention of Grace" (25). As a member of the elect, he receives divine assistance from the saving hand of God's Grace. This Grace sustains him

throughout his perilous experiences, allowing him to ultimately continue forward on his journey towards holiness.

Book I, Canto 7 of *The Faerie Queene* thus conveys the conflict the soul experiences during its physical experience on Earth. The Fall tainted the human body, rendering it susceptible to the temptation of sin. As we move forward in our daily lives we must defend ourselves against the deceptive lures of Evil and choose to follow the callings of God. In *The Faerie Queene*, Spenser depicts the cycle of weakness, temptation, sin, and chastisement to present the lessons of Christian doctrine through enlightening allegories that come to fruition in readers' minds and resonate with their souls.

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